IAS 100

A Civil Services Chronicle Initiative

SCIENCE & TECHNOLOGY

(PART-1)

Civil Services CHRONICLE

24 yrs of Guiding Success

Add : D-108, Sec-2, Noida (U.P.), Pin - 201 301
Email id : helpdesk@campus100.in
Call : 09582948810, 09953007628, 0120-2440265

CONTENTS

SCIENCE AND TECHNOLOGY IN INDIA

CHRONICLE
IAS ACADEMY
A CIVIL SERVICES CHRONICLE INITIATIVE

DEVELOPMENT HISTORY

In 1947, with the emergence of a new politically independent nation, India continued to march ahead pursuing a programme of using modern science and technology for national development. Today India spends about 1.5 per cent of its GNP on science and technology. In this effort not only has India established capabilities of its own but has also cooperated with developed as well as developing countries in its progress towards the use of science and technology for national development.

Soon after Pandit Jawaharlal Nehru became the Prime Minister of India, he created a Ministry of Scientific Research and Natural Resources, and actively supported the atomic energy programme for peaceful purposes. In 1948, the Atomic Energy Act was passed and the Department of Atomic Energy was directly under his charge. Till his death in 1964, he was the Chairman of the Council of Scientific and Industrial Research. His long association with the India Science Congress Association is well known. Under the farsighted leadership of Nehru, the nation, the government and the public leaders became committed to the promotion of science and technology for national development in a phased manner.

The enthusiastic efforts of Mr. Shanti Swarup Bhatnagar led to the expansion of the Council of Scientific and Industrial Research into a chain of national laboratories spanning a wide spectrum of science, technology, engineering and biomedical sciences. The vision of Homi J. Bhabha led to advanced research in nuclear energy and other fundamental areas through the creation of the Tata Institute of Fundamental Research (TIFR) and what has now come to be known as the Bhabha Atomic Research Center (BARC), and the entire gamut of activities today coming under the Atomic Energy Commission.

Soon after assuming office, Nehru appointed a Scientific Man-power Committee and had the satisfaction of seeing five Institutes of Technology come up at Kharagpur, Bombay, Madras, Kanpur and Delhi, besides a number of regional engineering colleges. A number of institutions for specialized training such as the National Institute of Foundry and Forge Technology, School of Planning and Architecture, the Institutes of Management and the All India Institute of Medical Sciences were set up. A similar expansion took place in science education. The number of universities and science graduates and post-graduates multiplied. Nehru diversified the area of operation in science and technology. India was the first country, originally on the foot-pound system, to change over the metric system during the present century. In 1948, Nehru directed the SCIR to prepare a National Register of Scientific and Technical Personnel. The Defence Science Organisation was set up in 1948, on the advice of Professor P.M.S. Blackett, for the scientific evaluation of weapons and equipment, operational research and special studies using scientific technique.

Prime Minister, Indira Gandhi gave the highest priority to self- reliance in science and technology and the achievement of self-sufficiency in food. In 1971, recognizing the importance of developing integrated and self-reliant electronic capabilities in the country, she set up the Electronics Commission. There have been many accomplishments in the field. To ensure that developmental activities took place in harmony with the environment, Mrs. Gandhi created a new Department of Environment at the Centre in 1980. It was at her initiative that the first Indian scientific expedition to Antarctica took place in December 1981. She was deeply aware of the great importance of energy for development and, in particular, the pressing needs in rural areas. Accordingly, she set up a Commission on Additional Sources of Energy in March 1981, and thereafter a Department of Non-Conventional Energy Source.

India's development plans have consistently emphasised the need for sustained investment in research and related activities leading to creation of substantial capacity and capabilities

in science and technology (S&T). The fruits of this effort are evident in India's nuclear and space programmes, information and communication technology services, automotive and pharmaceuticals industries and other areas.

As the Indian economy continues on the path of rapid, more inclusive and sustainable growth, it will be necessary to ensure that India's capabilities in S&T grow in strength. This is especially important if India is to become one of the major economies of the world over the next 20 years.

The country needs to move up from investing 1 per cent of gross domestic product (GDP) in the R&D sector to 2 per cent of GDP and more, as has been the case with several developed and emerging economies for quite some time now. This must be achieved not only through an additional government effort, but also a much increased private sector effort.

SCIENCE, TECHNOLOGY AND INNOVATION POLICY 2013

New Science, Technology and Innovation (STI) policy has been formulated and enunciated in 2013 and was formally released at the 100th Session of Indian Science Congress at Kolkata on 3rd January, 2013 by the Prime Minister Dr. Manmohan Singh. The policy seeks to focus on both STI for people and people for STI. It aims to bring all the benefits of Science, Technology & Innovation to the national development and sustainable and more inclusive growth. It seeks the right sizing of the gross expenditure on research and development by encouraging and incentivizing private sector participation in R & D, technology and innovation activities. Main features of the STI policy 2013 include:

- Promoting the spread of scientific temper amongst all sections of society.
- Enhancing skills for applications of science among the young from all social sectors.
- Making careers in science, research and innovation attractive enough for talented and bright minds.
- Establishing world class infrastructure for R&D for gaining global leadership in some select frontier areas of science.
- Positioning India among the top five global scientific powers by 2020 (by increasing the share of global scientific publications from 3.5 per cent to over 7 per cent and quadrupling the number of papers in top 1 per cent journals from the current levels).
- Linking contributions of Science Research and innovation system with the inclusive economic growth agenda and combining priorities of excellence and relevance.
- Creating an environment for enhanced private sector participation in R &D.
- Enabling conversion of R & D output with societal and commercial applications by replicating hitherto successful models, as well as establishing of new PPP structures.
- Seeking S&T based high risk innovation through new mechanisms.
- Fostering resource optimized cost-effective innovation across size and technology domains.
- Triggering in the mindset and value systems to recognize respect and reward performances which create wealth from S&T derived knowledge.
- Creating a robust national innovation system.
- Establishing linkages between discovery processes of science and developmental priorities of the country in agriculture, manufacturing, services and infrastructure sector.

SCIENCE AND TECHNOLOGY POLICY-2003

The "Science and Technology Policy-2003" envisages an implementation strategy for revitalization of the Science & Technology institutions in the country. The key elements of the strategy include:

(i) S&T governance and investment;

(ii) Strengthening of infrastructure for Science and Technology in academic institutions;

(iii) New funding mechanisms for basic research;

(iv) Human resource development;

(v) Optimal Utilization of Existing Infrastructure and Competence;

(vi) Technology Development, Transfer and Diffusion;

(vii) Indigenous Resources and Traditional Knowledge;

(viii) Technologies for Mitigation and Management of Natural Hazards;

(ix) Promotion of Innovation;

(x) Generation and Management of Intellectual Property;

(xi) Industry and scientific R&D;

(xii) Public Awareness of Science and Technology; and

(xii) International Science and Technology cooperation.

TECHNOLOGY MISSIONS

The "Technology Missions" were the brain child of Mr. Rajiv Gandhi. The missions started in 1985 and were an offshoot of the Seventh Plan. Launched in the fields of literacy, immunization, oilseeds, drinking water, dairy products and telecommunication, it had the following aims:

1. Make a substantial improvement in the literacy level of the population.
2. Immunize all infants against six diseases and women against tetanus.
3. Cut down imports of edible oils.
4. Improve the availability and quality of drinking water in rural areas.
5. Improve milk production and rural employment.
6. Extend and improve the telecommunication network especially in the rural areas.

In the light of the new industrial and economic policies adopted by the Government, the approach to technology development has had to be fine-tuned. Besides enhancing the flow of technology from abroad, the Department of Electronics has decided to launch a series of Technology Missions, essentially to meet the following three objectives:

(a) Strengthening the technology base infrastructure.

(b) Commercializing indigenous technologies which improve the performance of selected industries and their competitiveness.

(c) Focus attention on certain emerging and frontier technologies.

SCIENCE AND TECHNOLOGY INFRASTRUCTURE

Besides having the third largest scientific manpower, India also possess a large infrastructural network. Scientific and technological activities in India can be classified into these sectors, viz., (i) Central government; (ii) State government; (iii) higher education sector; (iv) public sector industry and; (v) non-profit institutions/associations. These institutional structures comprise mainly of major scientific departments of the Central Government, with their research laboratories, institutions, which are the main contributors to the research activities being carried out in the country. These are the Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), the Department of Atomic Energy (DAE), Defence Research and Development Organisation (DRDO), Department of Ocean Development (DOD), Department of Environment (DOE), and Ministry of Science and Technology comprising of three departments-Science and Technology, Scientific and Industrial Research and Biotechnology. Besides, there are other Central Government ministries/departments and number of research institutions under their administrative and financial control. In addition, there are in-house R & D units of public-sector undertakings. The private sector industries have established their own in-house R & D units, which are responsible for undertaking R & D activities for their respective industries. The state governments have their own research institution, which mainly comprise agriculture universities and their research stations besides having other research institutions directly under different departments of the state governments. Infrastructure for education, research and development has expanded enormously over the years.

1. Department of Science and Technology

The Department of Science and Technology, set up in 1971, has been concerned with various

facets of promoting Science and Technology in the Country. In this process, it has evolved policy statements and guidelines, provided mechanisms of coordination of areas of science and technology for which a number of institutions and departments have interests and capabilities, supported grants-in-aid of scientific research institutions and professional bodies.

By the very nature of the activities of the department, it has to play a catalytic and coordinating role, and, in this process over the past few years, the efforts at promoting science and technology in the states and union territories have also gathered considerable momentum.

The programmes of Department of Science and Technology are summarized below:

- Formulation of policies relating to S&T
- Promotion of new areas of S&T
- Support and Grants-in-aid to Scientific Research Institutions, Scientific Associations and Bodies.
- R & D Promotion Programme
- Technology Development
- S & T Programmes for Socio-economic Development
- Natural Resources Data Management System (NRDMS)
- S & T Entrepreneurship Development
- S & T Communication and Popularization
- Promotion of S&T at the State, District, and Village levels for grassroots development through State S&T Councils and other mechanisms.
- All other measures needed for the promotion of S&T and their application to the development and security of the nation.

2. India Meteorological Department (IMD)

The objectives of the India Meteorological Department (IMD) are to provide and forecast meteorological information on weather sensitive activities, warning against severe weather phenomena, and provide meteorological statistical data. The Department has its observatory and offices in different parts of the country.

- **National Centre for Medium Range Weather Forecasting (NCMRWF):** In ***order*** to study and analyze the weather and climate behaviour of particular interest to our sub-continent, the Department has set up a National Centre for Medium Range Weather Forecasting (NCMRWF) with the installation of a sophisticated supercomputer at its premises in New Delhi. The centre is involved in developing models, which will hopefully be able to predict the behaviour of monsoons at least seven to ten days in advance.
- **Survey of India (SOI):** The information obtained from accurate surveys are enormously useful for various development and strategic needs. The Survey of India (SOI), another premier organisation, is responsible for the production of topographical maps and providing services to defence forces and also to other users for various developmental activities. Modern facilities for map making, including the setting up of modern cartographical centre, digital mapping centre, etc. are some of the important schemes undertaken by the SOI.
- **National Atlas and Thematic Mapping Organisation (NATMO):** While Survey of India meets the national needs in cartography, etc., some specialized thematic maps required to meet the needs of specific users are taken care of by the National Atlas and Thematic Mapping Organisation (NATMO), operating under the Department.
- **Autonomous Scientific Institutions:** As part of its programmes for supporting science and technology activities in the country, the Department provides grants-in-aid to 13 autonomous scientific research institutions and the four national academies, including, the Indian National Science Academy, New Delhi and the India Academy of Science, Kolkata. Thirteen autonomous research institutions take up programme, which are in the frontline areas of life sciences, physical sciences and engineering sciences. These institutions, having a large body of scientists carrying out research, have made very valuable contribution in the form of research publication in prominent national and international journals.

3. Department of Atomic Energy (DAE)

India embarked on an ambitious nuclear power programme over four decades ago. The Atomic Energy Commission (AEC) set up in

1948, is the apex body, which lays down policies pertaining to atomic energy programmes. To execute these policies, the Department of Atomic Energy (DAE) was formed in 1954. The activities of DAE are grouped under research and development, nuclear power production and industries and minerals. The Department also extends financial support to several institutions carrying out basic research in nuclear and allied sciences.

- **Nuclear Power Programme:** To use the country's uranium and vast thorium resources, a three stage atomic power programme was envisaged in 1940s. The ongoing first stage uses natural uranium fuelled pressurized heavy water reactors (PHWRs) for producing electricity. The spent fuel when reprocessed yields plutonium, which can be used as fuel and results in production of more plutonium and uranium-233 when thorium is used as a blanket. The third stage reactors will be using uranium-233 in the thorium cycle.
- **Research and Development Units:** R & D activities of DAE, are concentrated at four research centres namely the Bhabha Atomic Research Centre, Kalpakkam; Mumbai; Indira Gandhi Centre for Atomic Research, Centre for Advanced Technology, Indore, and Variable Energy Cyclotron Centre, Kolkata.
- **Bhabha Atomic Research Centre (BARC):** Set up in 1957, the Bhabha Atomic Research Centre (BARC) is a premier research institution of the country working in nuclear sciences and related fields. The country's first 1- MW research reactor APSARA was built indigenously in 1956. In 1960, a 40 MW research reactor 'CIRUS' commissioned at Bombay for developmental work, including production of isotopes, experimentation, and training. 'CIRUS' is still in operation. A new high flux indigenous 100 MW reactor 'DHRUVA' was commissioned in August 1985 for research in advanced nuclear physics and production of isotopes. Other facilities of BARC include a research reactor PURNIMA III using Uranium-233 as fuel, a neutron source reactor KAMINI (at Kalpakkam), 5.5 MeV Van-de-Graaff accelerator set up in collaboration with TIFR, a Beryllium Plant (PREEFREE) and Waste Immobilisation Plant at Tarapur, and a seismic station at Gauribidanur (Karnataka). The Radiation Medicine Centre at Mumbai uses radioisotopes for diagnostic and therapeutic applications.
- **Indira Gandhi Centre for Atomic Research:** Set up in 1971, at Kalpakkam, near Madras, the Centre carries out R and D activities relating to fast breeder development. It has set up a FBTR, which is presently operating at a power level of 1 MWe, which will be gradually raised to the design value. Based on the experience gained from FBTR, this Centre has evolved a design for the prototype 500 MWe reactor (PFBR). The Centre is equipped with modern laboratories for carrying out work in metallurgy, radiochemistry and fuel reprocessing related to fast reactors.

Over the years, the centre has established comprehensive R & D facilities covering the entire spectrum of FBR technology related to Sodium Technology, Reactor Engineering, Reactor Physics, Metallurgy and Materials, Chemistry of Fuels and its materials, Fuel Reprocessing, Reactor Safety, Control and Instrumentation, Computer Applications, etc. and has developed a strong base in a variety of disciplines related to this advanced technology.

- **Centre for Advanced Technology:** The centre, set up in 1984 at Indore, Madhya Pradesh, has been developing technologies in the area of lasers and accelerators. The synchrotron radiation facility is being set up here which will be a major research facility in the country.
- **Variable Energy Cyclotron:** It is a premier R & D setup in 1980, a unit of the Department of Atomic Energy and one of the constituent institution of Homi Bhahba National Institute. This centre is dedicated to carryout frontier research and development in the feld of Accelerator Science & Technology, Nuclear Science (Theoretical and Experimental), material science & other relevant areas.

Public Sector Undertakings under DAE

- **Nuclear Power Corporation of India Limited (NPCIL):** The Corporation is responsible for designing, constructing, and

operating nuclear power reactors. At present it has eight reactors in operation, with a total installed capacity of 1500 MWe.

- **Uranium Corporation of India Limited:** The Uranium Corporation of India Limited (UCIL) was formed for mining, milling and processing of uranium ores. The Corporation operates Uranium mill at Jadugoda (Jharkhand) and two uranium mines at Jadugoda and Bhatin (Jharkhand). It also has facilities to recover minerals such as copper concentrates and molybdenum from the ores. Major projects under construction are at Narwapahar and Turamdih, both in Jharkhand, being set up for mining and milling of uranium ores. In 1950, the India Rare Earths Limited was incorporated as a company of DAE. It has mineral sand separation plants at Manavalakurichi (Tamil Nadu) and Chavara (Kerala), rare earths plant for Monazite processing at Alwaye (Kerala) and the Orissa Sand Complex (OSCOM) at Chhattarpur (Orissa). The major products of IREL are: ilmenite, rutile, zircon, rare earths chloride and others. It is a major exporter of rate earth minerals and value added products.
- **Electronics Corporation of India Limited:** In operation since 1967, ECIL has pioneered in the production of wide ranging indigenously developed sophisticated electronic systems, instruments and systems for use in the nuclear power programme and other industries. The Corporation is one of the leading organisations of the country in the field of manufacture of computers, control and instrumentation, communication system, and consumer electronics.
- **Board of Radiation and Isotope Technology:** Radioisotopes find extensive use in medicine, crop improvement, food irradiation, industry and research. To carry out activities in the above fields on commercial lines, the Board of Radiation and Isotope Technology was set up in March 1988.

Support to Research

The Department has been funding four institutions namely the Tata Institute of Fundamental Research (TIFR), Saha Institute of Nuclear Physics (SINP), Tata Memorial Centre (TMC) and Institute of Physics (IOP).

- The TIFR set up in 1945 at Colaba, Bombay, is engaged in fundamental research mainly in the fields of mathematics, physics, astrophysics, molecular biology and computer science. The facilities under TIFR include: Balloon Facility at Hyderabad, Radio Astronomy Centre and National Image Processing Facility for Astronomy at Ootacamund (Tamil Nadu) and FTNMR (Fourier Transform Nuclear Magnetic Resonance) national facility at Bombay.
- The Tata Memorial Centre at Bombay is the foremost institution in the country in research, diagnosis and treatment of cancer. It is also a premier education centre in oncology.
- The Saha Institute of Nuclear Physics, established in 1951 at Calcutta, is a major centre for advanced research in nuclear and allied sciences.
- The Institute of Physics at Bhubaneshwar has facilities for advanced research in nuclear science. A 3 MV Pelletron accelerator is a major research facility of the institute.

Atomic Energy Regulatory Board

The regulatory and safety function, as laid down in the Atomic Energy Act, 1992, are carried out by the Atomic Energy Regulatory Board (AERB) constituted in 1983. The Board is empowered to frame rules and regulations relating to safety and regulatory requirement for establishments engaged in works relating to and use of radiation. Safety standards, codes and guides to be followed by DAE and non-DAE nuclear installations are regularly issued. The Department's emergency preparedness and plans of all its nuclear installations are monitored by AERB.

4. Department of Space (DOS)

In India, space programme was formally organised in 1972 with the setting up of the Space Commission and the Department of Space. The primary objective of the programme is to

provide space based services in areas of communication, meteorology and resources survey and management and, as integral to it, develop satellites, launch vehicles and associated ground systems. The past two decades have already seen the Indian space programme making a remarkable progress through a well-integrated, self-reliant programme. Space communication has not only enhanced the communication capabilities in the country but also it is now being widely deployed for providing advanced disaster warning, search and rescue measures and distance education to remote areas.

Space Centre and Units

Research and development activities under the space programme are carried out in various centres / units of ISRO / DOS. The major projects of ISRO are executed by identified lead centres depending upon the technology base established in them.

- **Vikram Sarabhai Space Centre (VSSC)**, Thiruvananthapuram, is the lead centre for launch vehicle development and it pioneers in rocket research and the planning and execution of launch vehicle development projects.
- **ISRO Satellite Centre (ISAC),** Bangalore, is responsible for the design, fabrication, testing and management of satellite systems for scientific, technological and application missions.
- **Space Application Centre (SAC),** Ahmedabad, is ISRO's research and development centre for conceiving, organizing and building systems for practical applications of space technology. The major fields of activity cover satellite communications, remote sensing, meteorology and geodesy.
- **SHAR (Sriharikota High Altitude Rocket)** Centre, Sriharikota, located on the east coast of Andhra Pradesh, is the main launch centre of ISRO. This centre also undertakes large scale production of solid rocket propellant and ground testing of solid fuelled rocket stages of the Indian launch vehicles.
- **Liquid Propulsion Systems Centre (LPSC)** is the key centre for development of liquid propulsion systems. With its facilities located at Thiruvananthapuram, Bangalore and Mahendragiri, the Centre undertakes research, development and testing of liquid propulsion systems for ISRO's launch vehicle and satellite programmes.

5. Department of Electronics (DOE)

Productions of electronic equipment and component has come a long way since the days of radio receivers in 1940s. Electronics industry in India has grown with domestic demand as a result of import substitution efforts. In order to keep pace with developments in the international scene and also considering the increasing importance of electronics for diversified applications the Department of Electronics was set up by the Government of India in 1971. Since then, the Department has been coordinating development of electronics in India and reviewing constantly the growth achieved in the industrial front and in the R and D capabilities.

Manpower Development

The Department of Electronics has been supporting projects relating to manpower and skill development. The programme on generation of special manpower of computers aims at bridging the gap between supply and demand of trained manpower of computers. Activities under this programme include providing funds for courses such as M. Tech., B. Tech., MCA, PGDCA, etc and training for teachers of DCA, MCA and ITIs.

Seven Centres of Electronic Design and Technology (CEDT) have been set up for imparting training in design and manufacturing aspects of electronics products. The department has launched a pilot programme for Computer Literacy and Studies in Schools (CLASS) in participation with other PSUs like BEL, ECIL, ITI, BHEL, etc.

CMC Limited

CMC Ltd., set up in 1976 is committed to the creative use of computers and information technology tools in core sectors of the economy

through applications, which increase productivity and improve the quality of life. It provides hardware maintenance support to various equipments supplied by over 30 manufacturers. It coordinated implementation of project INCONET, which is an integrated information management and data processing facility spanning the entire country.

Electronics Trade and Technology Development Corporation Limited

ET and T was set up with objectives of expanding foreign trade in electronics and undertaking developments of technology in key areas. The Corporation has taken up a programme known as MTB programme to manufacture 17" B/W TV and 53 cm FST colour TV. Low cost PC project launched by ET and T to spread education through electronic media in a wider sense viz., curricular, vocational, community development, adult literacy and to make children available with educational video cassettes at an affordable price. It has also taken over total management of the Software Technology Park at Gandhinagar.

Semiconductor Complex Limited

Semiconductor Complex Limited (SCL) was set up primarily to design, develop and manufacture LS/VLSI circuits. SCL commenced commercial production in April 1984. Presently SCL is concentrating on rebuilding its assembly, test and wafer fabrication facilities and has expanded its product portfolio to keep pace with the current market trends. The company has also undertaken a turnkey project to set up a state-of-the-art Gallium Arsenide Enabling Technology Centre (GAETEC) at Hyderabad. It has achieved full capacity utilization in Quartz Analog Watch-Chip on Board and Electronic Circuit Block (QAW-COB and ECB) assembly lines.

Centre for Development of Advanced Computing (C-DAC)

In addition to the development of parallel computers and associated software, C-DAC has also initiated development programmes in other areas, including knowledge based computer systems (KBCS), language technology, VLSI design and rural technology. C-DAC started building Indian Language Computing Solutions with setting up of GIST group (Graphics and Intelligence based Script Technology); National Centre for Software Technology (NCST) set up in 1985 had also initiated work in Indian Language Computing around the same period.

Major focus of C-DAC was on consolidating and stabilizing its hardware products developed in the first mission, commercialization of products, carrying out R&D to enhance the throughput and power of the PARAM series of parallel computers, conduct research in the state of the art in advanced computing and develop new products in the language technology area.

C-DAC has today emerged as a premier third party R&D organization in IT&E (Information Technologies and Electronics) in the country working on strengthening national technological capabilities in the context of global developments in the field and responding to change in the market need in selected foundation areas.

6. Department of Scientific and Industrial Research: (DSIR)

It is a part of Ministry of Science and Technology. Apart from a number of its own units, it includes the Council of Scientific and Industrial Research (CSIR); National Research Development Corporation, Central Electronics and National Information System for Science and Technology (NISSAT). It has evolved programmes for absorption by industry. A National Register on Foreign Collaboration (NRFC) was started in 1985-86 for the creation of a data bank on the import of technology, analysis of financial, economic and legal matters pertaining to foreign collaborations (FCs), and preparation of reports on technology status in identified sectors/products. CEL has specialized in selected electronics components; specific electrical systems and Solar Photo-voltaic cells (SPV), modules and systems for a variety of applications.

Council of Scientific and Industrial Research (CSIR)

Council of Scientific and Industrial Research (CSIR), which was constituted in 1942 is an autonomous body registered under the registration of Societies Act, 1860. Functions assigned to the Council are: (i) promotion, guidance and coordination of scientific and industrial research in India, including the institution and financing of specific researchers;

	ORGANISATIONS UNDER CSIR	
CBRI	Central Building Research Institute	Roorkee (Uttarakhand)
CCMB	Centre for Cellular and Molecular Biology	Hyderabad
CDRI	Central Drug Research Institute	Lucknow
CECRI	Central Electro Chemical Research Institute	Karaikudi (T.N.)
CEERI	Central Electronics Engineering Research Institute	Pilani (Raj)
CFRI	Central Fuel Research Institute	Dhanbad
CFTRI	Central Food Technological Research Institute	Mysore
CGCRI	Central Glass and Ceramic Research Institute	Kolkata
CIMAP	Central Institute of Medicinal and Aromatic Plants	Lucknow
CLRI	Central Leather Research Institute	Chennai
CMERI	Central Mechanical Engineering Research Institute	Durgapur (W.B.)
CMRI	Central Mining Research Institute	Dhanbad
CRRI	Central Road Research Institute	New Delhi
CSIO	Central Scientific Instruments Organization	Chandigarh
CSIR	Council of Scientific and Industrial Research	New Delhi
IHBT	Institute of Himalayan Bioresource Technology	Palampur (H.P.)
CSMCI	Central Salt and Marine Chemicals Research Institute	Bhavnagar (Guj.)
ERDA	Electronics Research and Development Association	Vadodara
IICB	Indian Institute of Chemical Biology	Kolkata
IICT	Indian Institute of Chemical Technology	Hyderabad
IIP	Indian Institute of Petroleum	Dehradun
IMT	Institute of Microbial Technology	Chandigarh
INSDOC	Indian National Scientific Documentation Centre	New Delhi
ITRC	Industrial Toxicology Research Centre	Lucknow
NAL	National Aerospace Laboratory	Bangalore
NBRI	National Botanical Research Institute	Lucknow
NCL	National Chemical Laboratory	Pune
NEERI	National Environmental Engineering Research Institute	Nagpur
NGRI	National Geophysical Research Institute	Hyderabad
NIO	National Institute of Oceanography and Development Studies	Panaji, Goa
NISTADS	National Institute of Science, Technology and Development Studies	New Delhi
NML	National Metallurgical Laboratory	Jamshedpur
NPL	National Physical Laboratory	New Delhi
PID	Publication and Information Directorate	Delhi
RRL	Regional Research Laboratory	Bhopal, Jorhat, Thiruvananthapuram, Jammu, Bhubaneswar
TES	Tocklai Experimental Station	
SERC	Structural Engineering Research Centre	Chennai

(ii) establishment of and assistance to special institutions for scientific study of problems affecting particular industries and trades; (iii) establishment and award of research studentships and fellowships; (iv) utilization of the result of researches conducted under the auspices of the Council towards development of industries; (v) establishment, maintenance and management of laboratories, workshops, institutes and organisations to further scientific and industrial research. (vi) Publication of scientific papers and journals, and (vii) any other activity or activities to promote generally the objectives of the resolution.

Technological Boom to Industries: Ranging from antenatal oxygen analysis to a rapid test for presence of viruses in water, the CSIR's Madras complex (CMC) has come out with a bunch of technologies which will be a boon to different industries.

A conglomerate of the extension centres of six major laboratories, CMC, setup on a sprawling campus at Taramani on the outskirts of Madras, has more than met the objectives with which it was formed to develop new process and products, especially import substitutes, fight pollution in industry and environment, upgrade traditional crafts into productive and drudgery-free operations and assist in quality certification.

Assistance to Industry: The inter-disciplinary expertise generated over the year by CSIR helps industry in various ways. Some of them are: (i) assessment of technology options, including technology assessment and choice of technology; (ii) absorption, adaptation and updating of imported technology; (iii) identification or areas of R&D that will maximize returns, including R and D project definition, planning and programming; (iv) productivity improvement through cost reduction, energy conservation and waste utilization; (v) substitution of imported raw materials, components and process; (vi) pollution and effluents control, including location of safe discharge points; (vii) repair and maintenance; (viii) trouble shooting, condition monitoring and maintenance scheduling, computer simulation and modeling; (ix) optimization of novel technological designs; (x) analysis, interpretation and validation of tests results and data; (xi) laying down of standards and test-protocols and quality assurance; (xii) survey of literature and state-of-art-reports, and (xiii) feasibility studies and projects report and analysis.

7. Department of Ocean Development

India's coastline is more than 6000 km long and its territory includes 1256 islands. Its exclusive economic zone covers an area of 24 lakh sq km and the continental shelf extends upto 350 nautical miles from the coast. Indeed, the domain for the development of oceanic resources and protection of the marine environment extends from the coastal lands and islands to the wide Indian Ocean. Recognizing the crucial role that the ocean plays in influencing our climate, environment and resource base, the Government of India set up the Department of Ocean Development in 1981 to promote and coordinate the multifaceted endeavor needed to accomplish the task as well as to develop the new emerging area of Antarctic research and deep seabed mining.

National Institute of Oceanography: The National Institute of Oceanography was established in 1966 under the Council of Scientific and Industrial Research, New Delhi. The main objective of the Institute is to develop adequate knowledge related to physical, chemical, biological, geological and engineering aspects of the seas around India through: (i) study of physical process in the ocean, including monsoon; (ii) exploration of living resources of the sea; (iii) sea-farming technology; (iv) deep sea exploration for minerals; (v) coastal zone and harbour development; (vi) studies for effective control of marine pollution; (vii) ocean modeling; (viii) processing of satellite imagery data and (ix) acoustic topography.

8. Department of Biotechnology (DBT)

To promote R and D and manufacturing activities in the area of biotechnology, the Government set up the National Biotechnology Board in 1982. In February 1986, a separate Department of Biotechnology (DBT) in the Ministry of Science and Technology replaced the Board. The main responsibilities entrusted to the Department include planning, promotion and coordination of biotechnological programmes in the country.

The Department since its inception has been functioning with the advice of two advisory committees i.e. Scientific Advisory Committee

(SAC-DBT) and Standing Advisory Committee-Overseas (SACO). With the advice of SAC-DBT, 13 task forces have been constituted in the areas of : (i) aquaculture and marine biotechnology; (ii) animal biotechnology, veterinary sciences, animal husbandry and leather biotechnology; (iii) basic research emerging areas and R and D facilities; (iv) biochemical engineering, downstream processing and instrumentation; (v) bioinformatics; (vi) biological pests control, diseases and weeds; (vii) environmental biotechnology; (viii) fuel, fodder, biomass, horticulture and plantation crops and sericulture; (ix) industrial biotechnology; (x) microbial biotechnology; (xi) plant molecular biology and agricultural biotechnology.

Initiatives have been taken to promote transgenic research in plants with emphasis on pest and disease resistance, nutritional quality, silk-worm genome analysis, molecular biology of human genetic disorders, brain research, plant genome research, development, validation and commercialisation of diagnostic kits and vaccines for communicable diseases, food biotechnology, biodiversity conservation and bioprospecting, setting up of micropropagation parks and biotechnology based development for SC/ST, rural areas, women and for different States.

9. Department of Defence Research and Development (DRDO)

Defence Research and Development Organization (DRDO) was established in 1958 by amalgamating Defence Science Organisation and some of the technical development establishments. A separate Department of Defence Research and Development was formed in 1980 which now administers DRDO and its 48 laboratories/establishments.

The Department of Defence Research and Development formulates and executes programme of scientific research, design and development, fields of relevance to national security leading to the induction of new weapons, platforms and other equipment required by the Armed Forces. It also functions as the nodal agency for the execution of major development programmes of relevance to Defence through integration of research, development, public sector undertakings and other agencies. It functions under the control of the Scientific Adviser to the Defence Minister who is also the Secretary, Defence Research and Development.

Research and development activities at DRDO cover important demarcated disciplines like aeronautics, rockets and missiles, electronics and instrumentation, combat vehicles, engineering, naval systems, armament technology, including explosives research, terrain research, advanced computing, artificial intelligence, robotics, works study, systems analysis and life sciences, including high altitude agriculture, physiology, food technology and nuclear medicine.

DRDO offers specialized training at its two premier training institutions called Institute of Armament Technology, Pune and Defence Institute of Work Study, Musoorie. The courses at these institutes have been evolved to meet the needs of DRDO, Department of Defence Production and Supplies and the three services.

AUTONOMOUS INSTITUTIONS

The Department has set up under its administrative control two autonomous institutions in the country. These are the National Institute of Immunology (NII) at New Delhi and the National Facility for Animal Tissue and Cell Culture (NFATCC) at Pune. Both these institutions have independent governing bodies and scientific advisory committees. At NII, significant developments have been made in the field of immunodiagnostics. The facility at NFATCC acts as a cell repository, tissue bank in the area of molecular biology, immunology and cell products preparation. It has already supplied a number of consignments of cell lines to different laboratories in the country.

Indian Council of Agriculture Research (ICAR)

The Indian Council of Agricultural Research (ICAR) is a registered society and is the apex body responsible for promoting, conducting and coordinating research and education in the fields of agriculture, including horticulture, animal science, fisheries and the allied sectors in the country. With 99 ICAR institutes and 53 agricultural universities spread across the country this is one of the largest national agricultural systems in the world.

The ICAR has played a pioneering role in

ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development that has enabled the country to increase the production of foodgrains by 4 times, horticultural crops by 6 times, fish by 9 times (marine 5 times and inland 17 times), milk 6 times and eggs 27 times since 1950-51, thus making a visible impact on the national food and nutritional security. It has played a major role in promoting excellence in higher education in agriculture. It is engaged in cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.

In order to perform these functions in an integrated manner, the ICAR has created a National Grid of Cooperatives Research in which ICAR institutes, state agricultural universities and other educational and scientific institutions participate in their programmes as equal partners. In addition, the ICAR also operates 61 All India Coordinated Research Projects, which are multi-locational and multi-disciplinary in nature on important commodities and research areas. The mechanism of this coordinated research has proved its efficacy and utility over the last successive plan periods as an effective instrument to tackle the diverse problems characteristic of Indian agriculture.

Indian Council of Medical Research (ICMR)

The Indian Council of Medical Research (ICMR) is the apex body in India for the formulation, coordination and promotion of biomedical research. The Council's research priorities coincide with the National health priorities such as control and management of communicable diseases, fertility control, maternal and child health, control of nutritional disorders, developing alternative strategies for health care delivery, containment within safety limits of environmental and occupational health problems; research on major non-communicable diseases like cancer, cardiovascular diseases, blindness, diabetes and other metabolic and haematological disorders; mental health research and drug research (including traditional remedies). All these efforts are undertaken with a view to reduce the total burden of disease and to promote health and well-being of the population.

The primary functions of the Council are discharged through its permanent research institutes/centres/units, regional medical research centres, centres for advanced research, research units, task force projects and national multicentric collaborative projects in different parts of the country. In addition, there are ad hoc schemes and fellowships generated by active scientists in biomedical institutions/universities in different parts of the country. ICMR also attempts to strengthen indigenous capabilities, promote a broad-based and balanced cadre of research personnel in the country and develop facilities to tackle the present and future health problems.

CAPART

The Council for Advancement of People's Action and Rural Technology (CAPART) was registered under the Societies Registration Act, 1860, on 1 September, 1986, with headquarters in New Delhi with the merger of People's Acton for Development India (PADI) and Council for Advancement of Rural Technology (CART). It aims at encouraging, promoting and assisting voluntary action for enhancement of rural prosperity.

In pursuance of these objectives, CAPART makes available financial assistance to voluntary organisations under the following schemes: (i) Promotion of voluntary action in rural development (ii) Development of Women and Children in Rural Areas (DWCRA); (iii) Accelerated Rural Water Supply Programmes (ARWSP); (iv) Central Rural Sanitation Programme (CRSP); (v) Organisation of Beneficiaries of Anti-poverty Programme (OB); (vi) Integrated Rural Development Programme (IRDP); (vii) Jawahar Rozgar Yojana (JRY); and (viii) Advancement of Rural Technology Scheme (ARTS).

DEPARTMENT OF DEFENCE PRODUCTION AND SUPPLIES

A substantial part of defence stores needed by the Services is now being developed and produced in the country. The responsibility for this has been entrusted to the Department of Defence Production and Supplies in the Ministry of Defence. The Department directs and coordinates production of material and equipment required by the armed forces.

Ordnance Factories

At present, 41 ordnance factories spread all over India operate a wide-range of technologies and product mix. Some of the important products are field guns, anti-aircraft guns, various small arms, ammunition for weapons and guns, rockets, projectiles, pyrotechnics, bombs, grenades, mines, demolition clothing, optical and fire control instruments, engineering equipment, supply dropping equipment, including parachutes, rubberized items, various knitted and woven items like blankets, web equipment and a wide range of general stoppers are produced by them.

Defence Undertakings

There are eight public sector undertakings under the Department of Defence Production and Supplies. These are Hindustan Aeronautics Ltd. (HAL), Bharat Electronics Limited (BEL), Bharat Earth Movers Ltd. (BEML), Mishra Dhatu Nigam Ltd. (MIDHANI) and others. Seven of these undertakings are wholly owned by the Government of India.

- **Hindustan Aeronautics Ltd.,** set up in 1964, has 19 production divisions, 10 R & D Centres and one Facility Management Division spread across various locations at Bengaluru, Nashik, Hyderabad, Lucknow, Kanpur, Korwa, Koraput and Barrackpore, with its corporate office at Bangalore. The principal function of the company is to design, manufacture, repair and overhaul various types of aircrafts, helicopters and related aero engines avionics, instruments and accessories.

HAL is currently manufacturing SU-30MKI multi-role fighter, Hawk – Advanced Jet Trainer, Light Combat Aircraft (LCA), Intermediate Jet Trainer (IJT), Jaguar, Dornier 228 – Light Transport Aircraft, Dhruv (Advanced Light Helicopter), and Chetak, Cheetah and Cheetal helicopters and various types of aero-engines. HAL is also participating in future acquisitions planned by IAF and other Defence Services. These are Medium Multi-role Combat Aircraft (MMRCA), Multi-role Transport Aircraft (MTA), Fifth Generation Fighter Aircraft (FGFA) and Indian Multi Role Helicopters (IMRH) and Naval Multi-role Helicopter (NMRH).

- **Bharat Electronics Ltd.** was established in 1954 at Jalahalli, Bangalore. Since then, it has emerged as a leader in professional electronics. The company has core competencies in the areas of Radars & Weapon Systems, Sonars, Communication, Electronic Warfare Systems, Electro Optics and Tank Electronics, etc. It has nine units at Bangalore, Ghaziabad, Pune, Machilipatnam, Taloja, Panchkula and Kotdwara. Two support centres also exist at Hyderabad and Chennai. The products manufactured include low and high power communication equipment in the HF, UHF, VHF and microwave ranges; high power static and mobile radars, static and mobile troposcatters with line of sight equipment, broadcast transmitters, gun control equipment, weapons control system for frigates and electronic voting machines. BEL has been conferred the Navratna status on June 22, 2007.
- **Bharat Earth Movers Ltd. (BEML),** incorporated in 1964, commenced operations in January 1965. BEML is engaged in the design, manufacturing, marketing and after sales service of a wide range of mining and construction equipment, defence and aerospace products and rail and metro products such as excavators, bulldozers, dumpers, loaders, scrapers, cranes, etc.

BEML has its corporate headquarters and central marketing division at Bengaluru and 4 manufacturing complexes with 9 production units located in Bengaluru, Mysore, Kolar Gold Fields and Palakkad. It also supplies aircraft towing tractors to the Air Force and at present it is manufacturing transmissions and allied assemblies for combat vehicles. The Company's International Business covers over 58 countries in Asia, Africa, Europe and Latin America.

- **Mazgaon Dock Ltd.,** Mumbai, Goa Shipyard Ltd., Goa and Garden Reach Ship Builders and Engineers Ltd., Kolkata, are leading ship building and ship repairing units in the defence public sector having facilities to build sophisticated warships like frigates, seaward defence boats, survey vessels, offshore and onshore patrol vessels. MDL has constructed three indigenously designed Godavari class frigates.
- **Bharat Dynamics Limited** was incorporated at Hyderabad as a public sector

undertaking in 1970 with the prime objective of establishing a production base for guided missiles and for the development of missile production technology in the country. The company undertook the manufacture of SSIIBI, the first generation anti tank missile, under license agreement with M/s Aerospatiale of France. The company has commenced the manufacture of second generation anti tank missiles.

- **Mishra Dhatu Nigam Limited,** located in Hyderabad, was incorporated in 1973. The commercial production of the company started in July 1983. MIDHANI's product range includes super alloys, titanium alloys, maraging steels, heat resistant alloys, soft magnetic alloys, controlled expansion alloys, tungsten, molybdenum, etc., in a wide variety of mill forms. It is a unique, modern and integrated metallurgical plant for manufacturing a wide range of special metals and alloys for meeting the critical requirement of strategic industries such as space, defence, power, aeronautical, automobile, electrical, telecommunications, petrochemicals, lamp and general engineering industries.

SCIENCE AND TECHNOLOGY APPROACH TO TWELFTH PLAN

India had made substantial investments in the R&D sector during the Eleventh Plan period laying a strong foundation for building a vibrant and dynamic S&T sector in the country. Average growth rate of publications from India in scientific journals is about 14 per cent during the last three years of the Eleventh Plan period. This is against the global average of 4.1 per cent during the same period. The share of scientific publications emanating from universities increased from 15 per cent in 2003 to 31 per cent in 2012.

To face up to the increasing challenges in the new world order, the Indian S&T landscape needs to undergo a paradigm shift. It needs to evolve new delivery mechanisms for innovative deployment of technologies and business models for financing deployment of innovations. This calls for a well enunciated Science, Technology and Innovation policy. The Twelfth Plan should therefore work to develop an ecosystem that addresses the national priority for sustainable, inclusive and accelerated growth taking along the education, research and corporate sectors. The corporate sector, in particular, must play a much larger role in building research capability as happens in other countries.

A competitive knowledge economy must be built on the pillars of: (i) an educational system that produces human resources which are employable and globally benchmarked; (ii) S&T pursued on an enormous scale to generate knowledge for long-term use and (iii) strategic translational research inspired by national needs and global opportunities. In pursuit of these objectives the Twelfth Plan should be geared to achieve the following:

- Evolve a new Science, Technology and Innovation policy to bring in more resources from both public and private sector for R&D for socially and strategically relevant projects and mainstream innovation- related activities with a focus on affordable and sustainable innovations;
- Catalyse a radical but participative transformation of the Indian S&T system by refocusing the efforts of the designated Departments/Agencies at:
  - **National Focus—**build partnership with identified players of the National Innovation System to build the scientific, technological and human resource niches for the country;
  - **Organisational Focus—**address the needs of each Department/Agency for achieving the goals in national focus and rigorously review the ongoing projects/programmes to phase out those which have by and large fulfilled their goals; and
  - **Leadership Focus—**stimulate the Department/Agency's leadership in identified domains of science, technology and human resource development.
  - **Ensure that S&T becomes an integral component of the national developmental processes** by interconnecting competencies and

research resources and strengthening interconnections with the weakly connected stakeholders to the R&D outputs;

- Increase the number of full-time researchers/scientists from the current level of 1.54 lakh to 2.50 lakh; the volume of publication outputs in basic research from a global share of 3 per cent to, say, 5 per cent; improve the global ranking from 9th to 6th by the end of the Twelfth Plan; focus on doubling the number of patents and increase the commercialization of patent portfolio to 5–6 per cent from a level of less than 2 per cent;
- Increase R&D expenditure to 2 per cent of GDP and significantly enhance corporate sector R&D expenditure to at least 1 per cent of GDP by attracting investments and engaging the corporate sector in R&D through policy and reforms processes; earmark 10–15 per cent of public investment exclusively for public–private partnership (PPP) R&D to private sector through the competitive grant process with a stipulation that comparable provisions would be made by the private sector under PPP model;
- Provide more flexibility to the younger generation of scientists to pursue their ideas and greater mobility between industry, academia and R&D institutions; strengthen gender parity in R&D by way of mobility and women re-entry programmes; consolidate on the gains achieved during the Eleventh Plan in nurturing students to pursue science as a career;
- Build technology partnerships with States through new models of technological solutions, design, development and delivery;
- Initiate Grand Challenge Programmes and launch PAN-India missions to address national priorities in various developmental sectors through bottom up approach, particularly in the areas of Health, Water, Energy and Food through consortia of institutions and agencies cutting across public and private sectors; two major areas which require immediate focus during Twelfth Five Year Plan are Energy and Water;
- Encourage large Indian industries to establish globally benchmarked R&D centres on the lines of R&D centres set up by multinational companies (MNCs);
- Leverage the large-scale innovative component of strategic research spin-offs from defence, space and atomic energy for civilian benefits in a much larger segment.
- Create new Inter-University Centres (IUCs) and Inter-Institutional Centres (IICs) in chosen areas of Science and Engineering, which will provide access to state-of-the-art facilities and academic ambience for researchers in universities and academic institutions;
- Create new R&D institutions in trans-disciplinary science and engineering to achieve leadership positions;
- Create Peta-scale supercomputing facilities and provide high-performance computing for various applications such as climate modelling, weather prediction, aerospace engineering, computational biology, nuclear applications, earthquake simulations, animation in movies, national security and finance;
- Create an independent institutional arrangement for Technology Assessment capability.
- Partner with high-value global mega projects in the areas of contemporary scientific interest and technological relevance and enhance India's role in global mega projects; and
- Enhance collaboration with reputed foreign universities/agencies towards addressing the scientific aspects of common interest and global in nature.

❖❖❖

CHRONICLE
IAS ACADEMY
A CIVIL SERVICES CHRONICLE INITIATIVE

Health and human development form integral components of overall socio-economic development of any nation. Under the Constitution, Public health and sanitation, hospitals and dispensaries fall in the state list. Population control and family planning, medical education, adulteration of food stuffs and other goods, drugs and poisons, medical profession, vital statistics, including registration of births and deaths, lunacy and mental deficiency are in the concurrent list. Union Ministry of Health and Family Welfare plays a vital role in the national efforts to help citizens lead a healthy and happy life. The ministry is responsible for implementing programmes of national importance like family welfare, primary health care services, prevention and control of disease, etc. which form the main plank of our development efforts.

INDIAN MEDICINE SYSTEMS

The traditional systems of medicine are of great relevance to the health care of the people. It is calculated that majority of the world population are still relying on traditional system. Kerala is the first state in the country, which separates the traditional systems of medicine into Ayurveda, Siddha, Unani, Yoga & Naturopathy respectively. Indian systems of medicine (ISM) include all the non-allopathic systems of medicine and regimens, excluding Homeopathy, viz. Ayurveda, Siddha, Unani, Nature Cure, Yoga, Tibbia and Amchi.

Ayurveda and Siddha are the most ancient ISM practised in India. These deal with preventive, promotive and curative concepts of health and are holistic systems of medicine dealing with body, mind, soul and the phenomena of nature. Ayurveda makes use of the medicinal properties of plants. Siddha is practised mainly in Tamil-speaking and nearby areas

Unani system of medicine has a long and impressive record in India. Having its origin in Greece, it was introduced by the Arabs in India. It also adopts holistic approach. Main types of treatment are regimen therapy, diet therapy, pharmaco-therapy and surgery.

Naturopathy is commonly known as drugless treatment of disease and is based mainly on the ancient practices of the application of the simple laws of nature. It lays special emphasis on eating and living habits, adoption of purificatory measures, use of hydrotherapy, cold packs, mud packs, baths, massage, etc.

Yoga is as old as Ayurveda. It was about 2500 years back when Patanjali propounded it in a systematic form, which consists of eight components. Yoga helps in improving physical, mental and social well-being as also builds up improved resistance to disease and endurance against stress.

Homeopathy is based on the principle of Simila Similibus Curantur, i.e., like cures, and that too with minute doses of medicines, and was discovered by the German physician Dr. Christian Frederick Samuel Hannemann. Homeopathy has wide acceptability because of its holistic and intrinsic values, low cost medicines and absence of any side effects of the drug.

Sowa-Rigpa Became Part Of Indian Medical System:

The Parliament on August 31, 2010 adopted a Bill to recognise within the definition of Indian medicine the Sowa-Rigpa system practised in sub-Himalayan region of the country. The Indian Medicine Central Council (Amendment) Bill, 2010 was then passed by a voice vote by the Lok Sabha. Rajya Sabha had passed the Bill on August 25.

It is practiced in the sub-Himalayan region and other parts of the country, besides Tibet, Mongolia, Japan and some other countries. The Bill seeks to include registered practitioners of Sowa-Rigpa in the Indian Medical Council. The

Indian Medicine Central Council (Amendment) Bill, 2010, seeks to include Sowa-Rigpa along with Ayurveda, Siddha and Unani medicine in the system, set minimum standards for education, and maintain a register of all practitioners in these fields.

The Bill would ensure protection and preservation of the Sowa-Rigpa system and help in its development. Besides, it would lead to the setting up of a regulatory mechanism in the education and practice of Sowa-Rigpa. The government will take all steps for research and development of the Sowa-Rigpa system with a regulatory body in place. The legal recognition of 'Sowa-Rigpa' will help in preserving this ancient system of medicine along with boosting its education and practice. It will also open new avenues of research and development of new medicines by combining new techniques with 'Sowa-Rigpa'.

The government had also decided to set up a Pharmacopoeia Commission for Indian Systems of Medicine, which now would also include Sowa-Rigpa. The passage of the Bill will enable setting minimum standards for education and maintain a register of all practitioners of Sowa-Rigpa. It was being done as recommended by the National Medicinal Plant Board, which is working on Indian herbs and plants used in various traditional systems. A task force was set up by the Health Ministry to reach out to inaccessible areas and places, where tribals live in, to identify their system of medicine and practitioners.

- Sowa Rigpa or commonly known as 'Amchi' is an ancient system of Tibetan medicine.
- Since ancient times this system has been used to cure people in Sikkim, Jammu & Kashmir, Ladakh, Arunachal Pradesh and other Himalayan belt of the population.
- Sowa Rigpa is practiced in many countries. But due to its origin in ancient Tibet, it is also known as Tibetan medicine.
- This ancient system of treatment resembles Ayurveda but it also has some principles of Traditional Chinese Medicine.
- It is believed that Lord Buddha taught the fundamental text book rgyud-bzhi of 'Sowa-Rigpa'.

In order to strengthen the AYUSH systems and their revalidation, various initiatives have been taken by the Health Ministry. These include infrastructure development by establishing five Research Councils dedicated for research in each of the AYUSH systems; establishment of Pharmacopoeia Commission of Indian Medicine for developing standards of Ayurveda, Siddha and Unani drugs; promoting collaboration among various research councils under different ministries as well as universities and organizations. The interdisciplinary research involving scientists of basic sciences, chemists, pharmacologists, biologists as well as engineers has also been encouraged in core areas of research in AYUSH systems. These include Fundamental Research comprising of interpretation and revalidation of basic principles of AYUSH systems; Literature Research covering revival, preservation, translation, critical analysis, systematization and publication of manuscripts; Drug Research including Medical, Ethnic and Botanical Surveys, Cultivation of Medicinal Plants, Standardization and Quality control, Preclinical safety, Toxicity and Biological activity screening and Clinical Research encompassing observation studies and phased clinical trials. Modern advanced technologies like Genomics are also being used to study the fundamental concepts of Prakriti; i.e. Body constitution described in Ayurveda. AYUSH drugs are being studied with advanced techniques for their activity on immune systems in disease like HIV-AIDS, for Anti-cancer activity and Anti-diabetic activity. In order to make research findings in AYUSH systems and allied faculties accessible through the web, the Department of AYUSH has developed an AYUSH research portal which can be accessed by everyone.

During 12th plan period stress is likely to be given on Integration of AYUSH systems in health care delivery and their incorporation in National Health Programmes through co-locating such facilities at sub-centres and primary health care centres.

Some of the new initiatives which are under consideration during the 12th Plan include, setting up of a National Commission for Human Resource in; Referral hospitals in 8 National Institutes to provide world class treatment facilities; a National Institute of Medicinal Plants; Research and Quality Control Laboratories in 8

National Institutes; a Central Drugs Controller for AYUSH drugs to facilitate standardization of ASU products; 5 Hi-Tech Quality Control Labs under the Research Councils at regional levels; setting up of a Homoeopathic Medicines Pharmaceutical Corporation Limited to provide facilities for manufacturing of Homoeopathic medicines and to set up an All India Institute of Homoeopathy to fulfil the emerging interest of scientists for research in homoeopathy.

IMMUNITY AND IMMUNISATION PROGRAMMES

The resistance of the body to the effects of pathogenic organisms is called Immunity. It is an important defence mechanism of the body to fight against several diseases. Immunity may be active or passive.

Active Immunity: It develops as a result of the contact of an individual with pathogenic organisms or their products. These stimulate the body to produce antibodies (gamma globulin proteins) in response to the antigens (foreign substances). The immunity thus produced is specific for a particular disease, for example, the immunity established against chicken pox or measles is not effective against cholera or tuberculosis. Immunity may be acquired either through the infection of a pathogen or administration of a vaccine (a suspension of attenuated or killed microorganisms). Active immunity takes a few weeks to a few months to develop but persists for long periods.

Passive Immunity: It is produced when antibodies formed in one human being are transferred to another. It may be acquired through -

(i) Transmission of maternal antibodies to the foetus through the placenta e.g. chicken pox, measles, diphtheria, polio, tetanus.

(ii) Injection of antiserum (blood plasma containing anti-bodies) prepared against a specific disease e.g. tetanus, diphtheria or rabies.

(iii) Administration of immune globulins or human gamma globulins.

The transfer of lymphocytes also gives passive cellular immunity against viruses, intercellular bacteria, fungi and some protozoa.

Passive immunity is rapidly established but lasts for a short while. Passive immunization has therefore limited utility as compared to active immunization and is used mainly as a short-term preventive measure.

Immunization Programme

Reduced immunity of the body results in its unusually high susceptibility to infection and may lead to a number of disorders or diseases. Immune deficiencies may arise due to some genetic defects in the body. They may also be acquired as a consequence of malnutrition, metabolic abnormalities, and exposure to X-rays, toxic effects of drugs or pathogenic organisms.

A virus has been identified to be responsible for Acquired Immuno-Deficiency Syndrome (AIDS). The AIDS virus is believed to have originated in the African green monkey and then spread to humans. It is known to get transmitted from the infected persons to other not through casual contact, but through either sexual contact or blood transfusions or contaminated injection needles. In the host, this virus attacks those White Blood Corpuscles (WBC), which are responsible for developing the immunity. As it multiplies within the WBC at an exceedingly fast rate, it devastates the immune system of the body. AIDS virus can also cause serious damage to brain that may lead to loss of memory and impaired ability to speak and think. No suitable drug is known at present for treatment of the disease and no vaccine has so far been developed for use as preventive measure.

Recognising the potential of immunization as a low-cost efficient technology for child survival and prevention of disabilities, Government started the Expanded Programme on Immunization (EPI) in 1978 with the objective of reducing the morbidity, mortality and disability due to diphtheria, whooping cough, tetanus and tuberculosis by making free vaccination services easily available to all eligible children and expectant mothers.

Polio vaccine was included in the programme during 1979-80 and tetanus oxide in 1980-81. BCG was brought under EPI in 1981-82 and measles vaccine was initiated in 1985-86. The immunization programme is a long term one. The immunization services are provided through the existing health care delivery system.

The Universal Immunisation Programme (UIP) was launched in 1985 as part of the overall national strategy to bring down infant and maternal mortality in the country by providing immunisation to all infants against six vaccine-preventable diseases (tuberculosis, diphtheria, pertussis (whooping cough), tetanus, poliomyelitis, and measles) and pregnant women against tetanus. Prior to 1985, immunisation activity was implemented under the Family Welfare Programme, but the scheme was limited primarily to major hospitals and the coverage levels were also very low.

When this programme was launched in 1985, infant mortality for the country as a whole was 97 for every 1000 live births. It was estimated that vaccine preventable diseases were responsible for about one-fourth of the total infant deaths. Neo-natal tetanus itself was responsible for 13 out of every 1000 infant deaths, i.e., a total of 200,000 deaths every year. 150,000 children, in the absence of immunisation, are likely to develop paralytic poliomyelitis every year.

In 1986, the Universal Immunisation Programme was named as one of the Technology Missions and the following objectives were spelt out:

(a) To cover all pregnant women against tetanus and at least 85 per cent of all infants against six vaccine preventable diseases by March 1990.

(b) To increase production, upgrade testing facilities and develop the means, support and distribution of vaccines at the required low temperatures to maintain their potency.

(c) To achieve self-sufficiency in vaccine production and manufacture of cold chain equipment.

The programme was given the status of a National Technology Mission in 1986 (GoI, 1988) to provide a feeling of urgency and commitment to achieve the goals within the specified period. UIP became a part of the Child Survival and State Motherhood (CSSM) Programme in 1992 and Reproductive and Child Health (RCH) Programme in 1997. The Government of India constituted a National Technical Committee on Child Health on 11th June, 2000 and launched Immunization Strengthening Project on recommendation of the Committee. The Department of Family Welfare established a National Technical Advisory Group on Immunization on 28th August, 2001 to assist GoI in developing a nationwide policy framework for vaccines and immunization.

For almost two decades, UIP did not add any additional vaccine. However, since 2006, vaccines namely Hepatitis B, second dose of measles and Japanese Encephalitis (JE) vaccine have been introduced. During the same period, a number of other safe and efficacious vaccines have become available for major killers like pneumonia and diarrhoea, which are being used in the immunization programmes of many developing and developed countries.

According to United Nations Children's Fund (UNICEF) vaccine preventable diseases (VPDs) cause an estimated 2 million deaths or more every year, of which approximately 1.5 million deaths occur among children below five year age. These 1.5 million deaths represent approximately 15 percent of under-five deaths. Reducing child mortality by two thirds between 1990 and 2015 is the fourth of eight Millennium Development Goals endorsed by world leaders in the Millennium Declaration in 2000.

DESCRIPTION ABOUT DISEASES

1. Dengue

Dengue is a viral infection transmitted by the bite of an infected female Aedes mosquito. There are four distinct serotypes of the dengue virus (DEN 1, DEN 2, DEN 3 and DEN 4). Symptoms appear in 3–14 days (average 4–7 days) after the infective bite. Dengue fever is a flu-like illness that affects infants, young children and adults.

There is no specific treatment for dengue fever. Severe dengue is a potentially lethal complication but early clinical diagnosis and careful clinical management by experienced physicians and nurses often save lives.

More than 70 per cent of the disease burden is in South-East Asia and the Western Pacific. In Latin America and the Caribbean, the incidence and severity of disease have increased rapidly in recent years. The African and Eastern Mediterranean regions have also recorded more outbreaks of the disease in the last ten years.

Urbanization, rapid movement of people and goods, favourable climatic conditions and lack of trained staff have all contributed to the global increase of dengue.

The latest research has shown that the dengue fever virus can mutate much more rapidly than anyone though, which could thwart the efforts of the scientists to create a vaccine. Over the past few decades, the mosquito-borne virus has spread dramatically and now about 50 million people each year are affected in tropical areas. About 40 per cent of the world population is at risk. The phenomenon of global warming will further allow the virus to increase its range. The development of an effective vaccine that protects against each of the four main types of the dengue virus has proved difficult, as a successful vaccine might not remain effective for long. The scientists have found that two mutated strains of dengue-I caused 25 per cent of 15,000 cases in Myanmar in 2001. These strains evolved locally within a year. Two different dengue-2 strains had recombined in a mosquito to create a third strain, which showed the direct evidence that new strains can emerge anytime. In 2002 researchers found that two new strains of a dengue-3 virus in Thailand had evolved in less than a year replacing the dominant local strain and causing the biggest dengue epidemic in Thailand.

2. Cancer Control

In India, it is estimated that there are about two million cancer patients at any given point of time with 0.5 million new cases coming every year. The following new schemes have been initiated starting from the year 1990-91:

(i) **Scheme for district projects for preventive health education, early detection and pain relief measures:** Under the scheme financial assistance of Rs. 15 lakh is provided to the concerned State Governments for each district project selected under the scheme. The projects are implemented through the State Governments and concerned Regional Cancer Centres/ Government Medical Colleges having reasonably good facilities for treatment of cancer.

(ii) **Scheme for development of Oncology wings of Medical Colleges/hospitals:** This scheme has been initiated to fill up geographical gaps in the availability of cancer treatment facilities in the country. According to the scheme, financial assistance upto Rs. One crore is provided to the concerned State Government for procurement of equipment which includes one Cobalt Unit. The civil works and manpower are to be provided by the concerned State Government/Institution.

(iii) **Scheme for financial assistance to Voluntary Organisations:** Under the Scheme, financial assistance upto Rs. 5 lakh is provided to the registered voluntary organisations recommended by the State Government for the purpose, for undertaking health education and early detection activities in cancer.

3. Malaria Eradication

Malaria is one of the major public health problems of the country. Around 1.5 million laboratory confirmed cases of malaria are annually reported in India. The organised Public Health Programme to control malaria was launched in India in the year 1953, the encouraging results of which prompted Govt. of India to switch the strategy from control to eradication in 1958. The National Malaria Eradication Programme made spectacular progress till 1965. But this success was short-lived. In 1976, the number of confirmed malaria cases reached 6.47 million which necessitated renewed vigorous anti-malaria activities and the programme was modified.

After all these programmes, numbers of malaria cases have increased in the urban areas. The causative agent for common malaria, Plasmodium vivax, was eradicated satisfactorily while the Plasmodium falciparum responsible for spreading more lethal form of malaria, the cerebral malaria, showed an upward trend during 70s and thereafter. The multi-drug resistant strain of the disease also threatens to pose serious problems owing to inadequate coverage of the programme and lack of coordination between public and private health care systems.

It is proposed to intensify the efforts for the full containment of the disease to acceptable

levels. Accordingly, major focus is being given to insecticidal spraying for vector control in areas having more than 2/1000 cases reported and early cases detection and treatment. In the remaining areas, focal spraying and effective case surveillance is being taken up. These efforts are being appropriately developed with training of workers and enthusing community participation, alongside decentralisation of drug distribution and fever treatment etc.

Around 50 per cent of the total malaria cases reported is due to P.falciparum. One of the reasons attributed to rise in proportion of P. falciparum cases is resistance to chloroquine, which was used for a long time as the first line of treatment of malaria cases. P. falciparum infections are known to lead to severe malaria, if timely treatment with effective drugs is not administered.

With a view to bring down the incidence of malaria in the country, it is now under consideration to revise the approaches adopted earlier. The new strategy consists of an attempt to : (i) categorise the infected areas into high, moderate and low for a more focused, need-based, cost-effective and rational implementation of anti-malarial measures (this approach of malariogenic stratification is being attempted in the States of Maharashtra, Karnataka, Gujarat, Rajasthan, Andhra Pradesh and Madhya Pradesh); (ii) focused attention to the tribal areas of all 14 States (while tribals constitute 8 per cent of the P. falciparum cases in the country); and (iii) control urban malaria which is indicating a very high trend in the levels of incidence.

National Drug Policy on Malaria (2010)

The National Drug Policy on Malaria was first formulated in 1982 and has subsequently been reviewed and revised periodically. The present National Drug Policy for Malaria (2010) has been drafted keeping in view the availability of more effective antimalarial drugs and drug resistance status in the country.

Early diagnosis and complete treatment is one of the key strategies of the National Malaria Control Programme. All fever cases clinically suspected of malaria should be investigated for confirmation of malaria by either microscopy or Rapid Diagnostic Test (RDT). As and when the bivalent RDT is introduced, it will be used for diagnosis of malaria cases at the field level in remote areas where microscopy is not available within 24 hrs. of starting of fever. In high P.falciparum predominant areas where it is not possible to get microscopy results within 24 hours, ASHAs/other community health volunteers/MPWs should be provided with rapid diagnostic kits and anti-malarials (including ACT) for early diagnosis and treatment of P.falciparum cases.

Effective treatment of malaria under the National Drug Policy aims at:

- Providing complete cure (clinical and parasitological) of malaria cases.
- Prevention of progression of uncomplicated malaria into severe malaria and thereby reduce malaria mortality.
- Prevention of relapses by administration of radical treatment.
- Interruption of transmission of malaria by use of gametocytocidal drugs.
- Preventing development of drug resistance by rational treatment of malaria cases.

Urban Malaria Scheme

The Urban Malaria Scheme (UMS) came into effect in 1971. The main objective of the Scheme is to control malaria by reducing the vector population in the urban areas through recurrent anti-larval measures. At present, Urban Malaria Scheme is protecting 130.3 million population from malaria as well as from other mosquito borne diseases in 131 towns in 19 States and Union Territory.

Madhok Committee in 1970, investigated the problem and assessed that 10 to 12% of total cases were contributed by urban areas. The committee recommended anti larval measures for containment of urban malaria, because it was feared that proliferation from urban to rural may spread and nullify the gains already made.

4. Kala-Azar Control

Kala-azar has become a serious public health problem in Bihar and West Bengal. After its resurgence in Bihar in early 70s, the disease spread from 4 districts to adjoining areas and 30 districts in Bihar and 9 districts in West Bengal were affected by Kala-azar. As evident,

the problem has assumed serious dimensions in Bihar, where there has been a steep rise in reported incidence which itself is not an actual magnitude of the problem because some cases go to private practitioners and remain unreported.

In view of the rising problem, organised control measures were initiated to control Kala-azar. Until 1990-91, the assistance for Kala-azar control was being provided by Government of India out of NMEP budget provision.

The strategy for Kala-azar control broadly includes 3 major activities:

(i) Interruption of transmission for reducing vector population by undertaking indoor residual insecticidal spray twice annually,

(ii) Early diagnosis and complete treatment of Kala-azar cases, and

(iii) Health education for community awareness in its involvement.

Kala-azar Elimination Initiative

- National Health Policy Goal: Kala-azar Elimination by the year 2010 (which could not be attained).
- Elimination Programme is 100 per cent Centrally Supported (except regular staff of State governments & infrastructure).
- In addition to kala-azar medicines and insecticides, cash assistance is being provided to endemic states since December 2003 to facilitate effective strategy implementation by states.

5. Filaria Control

What is Filaria?

Filariasis is caused by several round, coiled and thread-like parasitic worms belonging to the family filaridea. These parasites after getting deposited on skin penetrate on their own or through the opening created by mosquito bites to reach the lymphatic system. The disease is caused by the nematode worm, either Wuchereria bancrofti or Brugia malayi and transmitted by ubiquitous mosquito species Culex quinquefasciatus and Mansonia annulifera / M.uniformis respectively.

Filariasis is a major public health problem in India. Whenever the disease becomes chronic, it is irreversible. The disease has been prevalent throughout India except Jammu & Kashmir, Punjab, Himachal Pradesh, Mizoram, Meghalaya, Tripura, Manipur, Rajasthan, Arunachal Pradesh, Delhi, Chandigarh, Haryana, Sikkim & Nagaland. Present estimate indicates that about 389 million people are living in 175 known endemic districts of which about 103 million are living in urban areas and the rest in rural areas.

For the control of Filariasis, the National Filaria Control Programme was launched in 1955. Under the Programme, the following activities have been undertaken:

(i) Delimitation of the problem in hitherto unsurveyed areas;

(ii) Control in urban areas through:

(a) Recurrent anti-larval measures.

(b) Antiparasitic measures.

The National Filaria Control Programme carries out anti-larval anti-mosquito measures, establishes filaria clinics and makes provision for underground drainage. Training in Filariology is imparted at three regional Filaria Training and Research Centres, situated at Calicut, Rajamundary and Varanasi under the National Institute of Communicable Diseases of Delhi.

6. Leprosy Eradication

Leprosy is a chronic infectious disease caused by Mycobacterium leprae. It usually affects the skin and peripheral nerves, but has a wide range of clinical manifestations. The disease is characterized by long incubation period generally 5-7 years and is classified as paucibacillary or mulitbacillary, depending on the bacillary load. Leprosy is a leading cause of permanent physical disability. Timely diagnosis and treatment of cases, before nerve damage has occurred, is the most effective way of preventing disability due to leprosy.

The Government of India launched the National Leprosy Eradication Programme in 1983 with the objective of arresting the transmission of the disease by 2000 A.D. It is a 100 per cent Centrally-sponsored programme.

The strategy adopted under the programme involves : (a) provision of domiciliary multi-drug treatment coverage in 135 districts having problems of 5 or more cases per 1000 population,

by specially trained staff in leprosy; (b) introduction of modified MDT scheme in the remaining 66 endemic districts through existing health care staff; (c) introduction of MDT services through existing general health care services in the low endemic districts ; (d) Multi-drug therapy to Dispose refractory cases in other districts. Treatment with combination of drugs includes treatment with 3 drugs, viz. Rifampicin, Clofazimine and Dapsone. Education of the patients and the community about the curability of the disease and their socio-economic rehabilitation are other two key components of the control strategy.

The national Institute of Immunology (NII), New Delhi has developed an anti- leprosy drug. It was introduced on January 30, 1998, the 50th death anniversary of Mahatma Gandhi.

The central government appointed a working group headed by the eminent scientist Dr M.S. Swaminathan to develop an action plan for eradicating leprosy. The working group's recommendations include:

- Control programme should be renamed as eradication programme with time bound and specific goal of arresting the disease activity in all leprosy cases by the turn of the century;
- Existing dapsone monotherapy supplemented with one or more bactericidal drugs (multi-drug treatment) for treatment of the disease to achieve cure of diseases;
- Efforts should be made to obtain self-sufficiency in the requirements of anti-leprosy drugs;
- Activities of voluntary organisations in leprosy control should be recognised, supported and dovetailed into the national programmes;
- Leprosy Act of 1898, which discriminated against leprosy patients should be repealed;
- Setting up of National Leprosy Eradication Commission (NLEC) under the Chairmanship of Union Minister of Health and Family Welfare for programme policy guidance and National Leprosy Board (NLEB) under the chairmanship of Union Health Secretary for monitoring the activities of the programme.

Milestones in NLEP

- 1955 - National Leprosy Control Programme (NLCP) launched.
- 1983 - National Leprosy Eradication Programme launched.
- 1983 - Introduction of Multidrug therapy (MDT) in Phases.
- 2005 - Elimination of Leprosy at National Level.
- 2012 - Special action plan for 209 high endemic districts in 16 States/UTs.

7. Tuberculosis

In India today, two deaths occur every three minutes from tuberculosis (TB). But these deaths can be prevented. With proper care and treatment, TB patients can be cured and the battle against TB can be won. Tuberculosis has taken the form of an epidemic in India and remains the leading infectious cause of death in the country, killing close to 500,000 people each year. The country also has about 2 million new cases of TB each year, far more than any other country, and accounts for nearly one-third of the global burden of TB.

Tuberculosis (TB) is an infectious disease caused by a bacterium, Mycobacterium tuberculosis. It is spread through the air by a person suffering from TB. A single patient can infect 10 or more people in a year.

India has a long and distinguished tradition of research in TB. Studies from the Tuberculosis Research Centre in Chennai and the National Tuberculosis Institute in Bangalore provided key knowledge to improve treatment of TB patients all around the world.

What is more frightening, the incidence of multi-drug resistant TB has been rising rapidly, underscoring an urgent need to take remedial measures. There are two reasons why TB has assumed alarming proportion. First it has been seen that treatment in most cases has been irregular and inadequate due to variety of reasons, poverty being the single most important one. People do not pursue the long-drawn treatment schedule and relapses are quite common.

Second, there are lots of quacks in this field and the government's direction is completely lacking. Also, since Tuberculosis is a micro bacterial droplet infection, it is quite common among the lower strata of the society where proper hygiene levels are not maintained. It is also quite prevalent at places which are overcrowded and over populated like J.J. Clusters.

Directly Observed Treatment, Short-course (DOTS)

The DOTS strategy along with the other components of the Stop TB strategy, implemented under the Revised National Tuberculosis Control Programme (RNTCP) in India, is a comprehensive package for TB control. The DOTS strategy is cost-effective and is today the international standard for TB control programmes. To date, more than 180 countries are implementing the DOTS strategy. India has adapted and tested the DOTS strategy in various parts of the country since 1993, with excellent results, and by March 2006 nationwide DOTS coverage has been achieved.

Multi-drug-Resistant Tuberculosis (MDRTB)

MDRTB refers to strains of the bacterium which are proven in a laboratory to be resistant to the two most active anti-TB drugs, isoniazid and rifampicin. Treatment of MDRTB is extremely expensive, toxic, arduous, and often unsuccessful. DOTS has been proven to prevent the emergence of MDRTB, and also to reverse the incidence of MDRTB where it has emerged. MDRTB is a tragedy for individual patients and a symptom of poor TB management. The best way to confront this challenge is to improve TB treatment and implement DOTS.

Second Phase of RNTCP

In the first phase of RNTCP (1998-2005), the programme's focus was on ensuring expansion of quality DOTS services to the entire country. There are many challenges remaining that are to be addressed in order to achieve the TB-related targets set by the Millennium Development Goals for 2015 and to achieve TB control in the longer term.

The RNTCP has now entered its second phase in which the programme aims to firstly consolidate the gains made to date, to widen services both in terms of activities and access, and to sustain the achievements for decades to come in order to achieve ultimate objective of TB control in the country.

All components of new Stop TB Strategy are incorporated in the second phase of RNTCP. These are:

- **Pursue quality DOTS expansion and enhancement**, by improving the case finding are cure through an effective patient-centred approach to reach all patients, especially the poor.
- **Address TB-HIV, MDR-TB and other challenges**, by scaling up TB-HIV joint activities, DOTS Plus, and other relevant approaches.
- **Contribute to health system strengthening**, by collaborating with other health programmes and general services.
- **Involve all health care providers**, public, non-governmental and private, by scaling up approaches based on a public-private mix (PPM), to ensure adherence to the International Standards of TB care.
- **Engage people with TB, and affected communities** to demand, and contribute to effective care. This will involve scaling-up of community TB care; creating demand thorugh context-specific advocacy, communication and social mobilization.
- **Enable and promote research** for the development of new drugs, diagnostic and vaccines. Operational Research will also be needed to improve programme performance.

8. Blindness

India has the largest blind and potentially blind population in the world. Cataract, which is curable, is the major cause (nearly 80 per cent), followed by trachoma, smallpox, malnutrition, vitamin A deficiency, injuries and glaucoma. 85 per cent of blindness is either preventable or curable.

National Programme for Control of Blindness (NPCB) was launched in 1975-76 which incorporated the earlier Trachoma Control Programme started in 1963. This was 100 per

cent Centrally sponsored scheme with the goal to reduce the prevalence of blindness from 1.4 per cent to 0.3 per cent. As per Survey in 2001-02, prevalence of blindness was estimated to be 1.1 per cent. Target for the 10th Plan was to reduce prevalence of blindness to 0.8 per cent by 2007 prevalence of Blindness was 1 per cent (2006-07 Survey).

The approach under the UPCB consists of intensive health education for eye care through the mass media and extension education methods; extension of ophthalmic services in the rural areas through mobile units and eye camps and establishment of permanent infrastructure for eye health care as an integral part of general health services. Since 1981-82, cataract operations have been accorded high priority in the programme and targets for different States/ UTs have been set.

The concept of District Blindness Control Societies (DBCS) has been successfully implemented under the programme. The programme is receiving assistance from Danish International Development Agency (DANIDA). A project has been approved under the World Bank to boost up the activities of the programme in seven major States- Andhra Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, Orissa, Uttar Pradesh and Rajasthan.

The objectives of the NPCB are: -

- To reduce the backlog of blindness through identification and treatment of blind.
- To develop Eye Care facilities in every district.
- To develop human resources for providing Eye Care Services.
- To improve quality of service delivery.
- To secure participation of Voluntary Organizations in eye care.

9. Goitre Control

Iodine is required for the synthesis of the thyroid hormones, thyroxine (T4) and triiodothyronine (T3) and essential for the normal growth and development and well being of all humans. It is a micronutrient and normally require around 100-150 microgram for normal growth and development. Deficiency of iodine may cause following disorders: Goitre, Subnormal intelligence, Neuromuscular weakness, Endemic cretinism, Still birth, Hypothyroidism, Defect in vision, hearing, and speech, Spasticity, Intrauterine death, Mental retardation.

Endemic goitre has been recognised as an age-old health problem in the Himalayan belt with recent extensive studies. It is now established that about 17 crore people in the country are exposed to Iodine-deficiency disorders. Out of which, it is estimated that about 4.5 crore people are suffering from some of the manifestation of these disorders. National Goitre Control Programme (1962) is being implemented on a priority basis. The Government of India has decided to iodise the entire edible salt in the country in a phased manner with a view of ensuring proper monitoring and effective implementation of the National Goitre Control Programme. State/ Union Territories have been advised to establish a goitre cell.

In recent years, it has become increasingly clear that iodine deficiency leads not only to goitre, but also to other Iodine Deficiency Disorders (IDD) like still births, cretinism, neo-natal hypothyroidism, juvenile hypothyroidism, impaired hearing and brain development and function. Recognising the widespread IDD in India, the Government has redesignated NGCP as National Iodine Deficiency Disorders Control Programme (NIDDCP). Iodine deficiency has been identified all over the world. It is a significant health problem in 130 countries and affects 740 million people. One third of the world population is exposed to the risk of IDD.

It is estimated that in India alone, more than 6.1 crore people are suffering from endemic goitre and 88 lakh people have mental/ motor handicaps. A national level survey has been carried out in 25 states and 5 union territories in the country and found that out of 282 districts surveyed, in 241 districts it is a major public health problem where the prevalence rate is more than 10%. It is estimated that more than 71 million persons are suffering from goitre and other iodine deficiency disorders like mental retardation, deaf mutism, squint, and neuromotor defects.

Programme

Following the successful trial of iodised salt in Kangara valley, Himachal Pradesh in 1962, India has launched a 100 per cent centrally sponsored National Goitre Control Programme. In 1992, the National Goitre Control Programme (NGCP) was renamed as National Iodine Deficiency Disorder Control Programme (NIDDCP).

Objectives

- Initial survey to identify magnitude of problem in the country;
- Production and supply of iodized salt to the endemic regions;
- Health Education & Publicity;
- To undertake monitoring of the quality of iodized salt assessing urinary iodine excretion pattern and monitoring of Iodine Deficiency disorder; and
- Re-survey in goitre endemic regions after five years continuous supply of iodized salt to assess the impact of the control programme. The result of re-survey in some areas has revealed that the prevalence of goitre has not been controlled as desired.

10. Anthrax

Anthrax is primarily an infectious bacterial disease of animals, particularly herbivores such as cattle, sheep, horses, mules and goats where this disease was known to cause uncontrolled mortality at one time. These animals usually get infected by ingestion of the anthrax spores while grazing on contaminated soil and drinking water contaminated with anthrax spores. Human beings invariably contract anthrax by direct or indirect contact with diseased animals; handling infected animal products like flesh, bones, hides and hair, eating infected meat and of course, by breathing weaponized anthrax spores.

The severity of anthrax infection in human beings depends upon many factors such as the route of infection, nutritional status of the host and also the virulence of the infected strain. Three types of anthrax occurs in human beings-cutaneous anthrax acquired through a skin lesion, gastrointestinal anthrax contracted through ingestion of contaminated meat of infected animals or drinking water containing anthrax spores and lastly, pulmonary or inhalation anthrax caused by breathing in of air borne spores.

Symptoms: In the first few days of infection, the patient develops influenza-like symptoms with fever and mild pain in chest. As it gains a firm foothold in the host body, there occurs a massive release of bacterial toxins which causes the lymph nodes to break down and bleed, thus spreading the infection in the chest. Infected fluids slowly build up in the lungs causing difficult breathing and high fever. Death occurs due to toxin- induced shock. Control measures for breaking the cycle of anthrax infection include:

- Quick disposal of anthrax carcasses.
- Disinfection, decontamination and disposal of all contaminated materials.
- Vaccination of exposed susceptible animals and humans involved in at risk occupations.

Anthrax bacterium genome sequenced: TIGR (The Institute for Genomic Research) deciphered the genome of an isolate of the so-called "Ames strain of Bacillus anthracis. Scientists say they have found potential new targets for drugs and vaccines against the anthrax germ by deciphering and analyzing the bacterium's complete genetic makeup. Researchers identified several genes that might play key roles in anthrax infections. Such genes might prove to be good leads for developing new treatments. The effort is crucial for anthrax, which can be lethal, as it is a potential weapon of future terrorism.

11. Hepatitis-C

Although the world is full of nasty viruses, the Hepatitis-C virus is particularly trickier. Medical science recognised decades ago that not all cases of hepatitis were caused by the two viruses (A and B) that have already been identified. But Hepatitis-C virus (HCV), which is spread mainly by contaminated blood from shared syringes, was not isolated and identified until 1989.

HCV is believed to have infected some 170 million people and another 3 million join their ranks every year. In most cases it settles down to form a chronic infection of the liver which,

over the course of several decades, can lead to severe forms of liver damage such as cirrhosis and fibrosis, as well as cancer.

According to the World Health Organisation, Hepatitis-C kills around 500,000 people a year. It is less deadly than AIDS, which claims more than 3 million lives annually. However its higher prevalence (at the moment, some 42 m people are infected with HIV), longer incubation period and the absence of effective drugs, mean that it is potentially a more lethal epidemic. Considering the severity of this nasty virus immediate steps are needed to tackle it. German scientists have shown that a molecule code named BILN 2061 can block the activity, both in the test tube and in experimental animals, of an HCV protein called NS 3 protease, without which the virus cannot go about its business. More significantly, the drug also seems to work in people. Although this is a significant success, we have to go a long way to achieve the final therapy.

12. West Nile

West Nile virus (WNV) is a mosquito-borne zoonotic arbovirus belonging to the genus Flavivirus. This flavivirus is found in temperate and tropical regions of the world. It was first identified in the West Nile subregion in the East African nation of Uganda in 1937. Prior to the mid-1990s, WNV disease occurred only sporadically and was considered a minor risk for humans, until an outbreak in Algeria in 1994, with cases of WNV-caused encephalitis, and the first large outbreak in Romania in 1996, with a high number of cases with neuroinvasive disease. WNV has now spread globally.

West Nile is one of the emerging infectious diseases. West Nile virus is spread to people by mosquitoes, usually producing mild, flu-like symptoms but can cause a deadly encephalitis or inflammation of the brain. The virus was first detected in the United States. Since then, it has spread rapidly from the northeastern United States throughout North America; this year it has again made havoc, claiming 10 lives and making over 500 sick.

The US researchers have created a promising vaccine against West Nile virus by replacing part of a distantly related virus with proteins from the West Nile virus, creating a hybrid virus vaccine. It protects monkeys from West Nile virus and human chemical trials of the vaccine are expected to begin soon. This vaccine will provide long term immunity to West Nile virus.

SEXUALLY-TRANSMITTED DISEASE CONTROL

Sexually-transmitted diseases (S.T.D.) like syphilis and gonorrhoea are fairly widespread in India. For the management and control of STD, the Government initiated a centrally -aided National Control Programme on STD during the Second Five year plan.

S.T.D. was introduced as a National Control Programme during the Second Five year Plan by the Government of India. The Programme was then primarily a Centrally- aided scheme concerned mainly with: (i) establishing S.T.D. clinics throughout the country; (ii) supply of drugs to the earlier existing and newly established clinics; and (iii) conducting training courses for the in-service medical and para-medical personnel.

The scheme was, however, converted into a Centrally- sponsored scheme during the Fourth Five year Plan and the Central government assistance was limited to (i) giving grants-in-aid to States for establishing new STD clinics, and (ii) supplying drugs (Benzathine, Penicillin) to the STD clinics for the in-service medical and paramedical personnel.

Recognising STD as one of the major factors for transmission of HIV infection, the programme has been merged with the AIDS Control Programme. The existing components of the programme, viz. teaching, training, and research however, has been retained outside the World Bank assisted activities of the National AIDS Control Programme.

AIDS Programme

HIV infection in the country has been reported from as many as 23 States/UTs, and of these Maharashtra, Tamil Nadu, Delhi and Manipur have the highest incidence. In Maharashtra and Tamil Nadu, the pattern of HIV infection is that of sub-Saharan type, i.e., through sexual transmission. In the North Eastern States, the pattern of HIV infection follows a course similar to that of Southern Europe and Thailand, i.e., through drug abuse.

Ministry of Health and Family Welfare has

set up a National AIDS Control Organisation as a separate wing within the Ministry to implement and closely monitor the various components of the programme as documented in the Staff Appraisal Report of I.D.A. (World Bank). The ultimate objective of the project would be to arrest the pace of HIV infection in the country with a view to reducing the future morbidity, mortality and impact of AIDS.

The Project would consist of the following components:

(i) **Strengthening Programme Management Capabilities:** National AIDS Control Organisation would primarily be involved in planning, consulting, implementing and monitoring the various activities under the project through the AIDS Control Cell at the State/UT level.

(ii) **Strengthening of IEC :** The project would seek to carry out an intensive public awareness and community support campaign through mass media and sustained dissemination of information and health education about HIV and AIDS to all levels and categories of personnel.

(iii) **Prevention of Transmission through Blood and Blood Products:** The project seeks to upgrade the blood banking capabilities in the public sector and expansion of HIV screening of all blood used for transfusion and blood-products in the country.

(iv) **Strengthening Clinical Management capabilities:** The project seeks to strengthen the institutional capabilities at the State/UT level for monitoring the development of HIV and AIDS epidemic and planning and programming interventions to control such epidemics.

(v) **Controlling S.T.D.:** One of the predominant mode of transmission of HIV infection is through sexual contact. The project seeks to take up activities to strengthen the clinical services and case management activities in STD centres.

The Disease: It is the late stage of infection with the Human Immuno Deficiency Virus (HIV). The Virus is of course much older and it is believed that it originated in Africa. This was first identified by chemical medicine in the United States and it was only in 1981 that the world was alerted to what has become a global scourge rivaling the medieval plague.

AIDS can take around 7-10 years to develop after infection with HIV. The AIDS virus causes a weakness of the immune system. It attacks the cells responsible for maintaining our immuno response called lymphocyte. When it infects the body, it prefers to cells of our defence system. These cells are called helper T cells which are a fundamental part of our immune system. The AIDS virus almost fully specialises on these white blood cells since these helper T cells have CD 4 molecules on the surface to which the AIDS virus binds.

To put it simply, the AIDS virus consists of genetic information on the inside and a protective outer shell of proteins and glycoproteins. Since viruses use the host cell's resources for reproduction, they do not need to contribute much of itself. That is why they are much smaller than the host cells, e.g. helper T cells. In the host cell's nucleus, there is more than 100,000 times as much genetic information stored than under the protein shell of the AIDS virus. However, there is no way to stop the virus once the cell has been infected.

AIDS now kills about three lakh Indian adults each year. This is roughly 15 times the number of people killed in the Gujarat earthquake. It was first noticed in 1986 when six sex workers of Chennai were found infected with HIV. Since then some 20 lakh to 25 lakh Indians have died of AIDS.

The 2006 estimates suggest national adult HIV prevalence in India is approximately 0.36 per cent, amounting to between 2 and 3.1 million people. If an average figure is taken, this comes to 2.5 million people living with HIV and AIDS; almost 50 percent of the previous estimate of 5.2 million.

More men are HIV positive than women. Nationally, the prevalence rate for adult females is 0.29 per cent, while for males it is 0.43 per cent. This means that for every 100 people living with HIV and AIDS (PLHAs), 61 are men and 39 women. Prevalence is also high in the 15-49 age group (88.7 percent of all infections),

indicating that AIDS still threatens the cream of society, those in the prime of their working life.

AIDS is the record largest killer of Indian adults; second only to T.B. Heterosexual contact is the most prevalent mode of transmission here in which infected males have the largest contribution (90 per cent). Infection through blood and blood products account for 7 per cent only of the total AIDS cases, 89 per cent are in the age group of 15-44 years. About 70 per cent infections are reported to be among men and 85 per cent transmission are through multipartner sex- both among high risk group and general population.

If the rapid rate continues, AIDS- caused deaths will outstrip TB very soon. At a minimum, between 40 lakh to 50 lakh Indians are currently infected, not including the 20 lakhs to 25 lakhs who have already died. Another five lakh Indian adults are getting infected every year- one new adult every minute!

Three states- Maharashtra, Andhra Pradesh and Karnataka- are in the midst of full-blown epidemic, with well over two per cent of all adults infected. Another three states follow just behind- Tamil Nadu, Manipur and Nagaland. In about eight to ten urban areas of these six states, three to five per cent of adults are infected. These include such major cities as Pune, Kolhapur and Hyderabad. These are among the most severely affected areas outside Africa, on par with Thailand, which has been battling a severe epidemic for a decade. And every year, the number of states with worsening epidemics swells- Kerala just crossed the one per cent infection level against adults, and even remote Orissa is nearly there.

It is not just the poor who are contracting HIV. For proof, look at the members of the Positive People's Group that are mushrooming in every major urban area, from Delhi to Bangalore to Vajayawada- they are middle and upper income, not blue- collar, not poor.

How to check the pandemic

- India will not be able to avert an epidemic unless our politicians, bureaucrats and journalists immediately end their knee-jerk response to AIDS. An essential first step is to end our foolish denial that our society is somehow impervious to AIDS, which it cannot go the way of Africa.
- We then need to insist that our health care system is improved, right-away. The Government simply has to find the money and commitment to ensure that every Indian has access to decent health services, including prevention and care for sexually transmitted diseases and T.B. HIV/AIDS cannot be fought where health services barely exits.
- National AIDS Control Organisation (NACO) be run in a committed, transparent and participatory fashion, serving the needs of all Indians, not as the high-handed, secretive, stonewalling bureaucracy.
- Our efforts should be dedicated to ensuring that no more Indians get infected, and that no more die because they cannot afford treatment with anti- retroviral and other medicines. All Indians should mandatorily be given comprehensive sex education that will dispel the confusion about HIV/AIDS and enable them to protect themselves. In addition, young people everywhere must have regular face to face counselling on safe sex.
- Laws and policies should also be changed to empower and protect people already infected or those especially from vulnerable groups.
- Discrimination in the private sector against infected people must be made illegal.

MENTAL HEALTH

The government of India decided to launch the National Mental Health Programme (NMHP) during the 7th Five year Plan period in 1982 to ensure availability and accessibility of minimum mental health care for all in the foreseeable future, particularly to the most vulnerable and under-privileged sections of the population, to encourage application of mental health knowledge in general health care and social development, and to promote community

participation in the mental health service development and stimulate efforts towards self help in the community.

Aims of NMHP

1. Prevention and treatment of mental and neurological disorders and their associated disabilities.
2. Use of mental health technology to improve general health services.
3. Application of mental health principles in total national development to improve quality of life.

Objectives of NMHP

1. To ensure availability and accessibility of minimum mental health care for all in the foreseeable future, particularly to the most vulnerable and underprivileged sections of population.
2. To encourage application of mental health knowledge in general health care and in social development.
3. To promote community participation in the mental health services development and to stimulate efforts towards self-help in the community.

- **Alzheimer's disease**

Alzheimer's disease is a progressive, degenerative disease that attacks the brain and results in impaired memory, thinking and behaviour. It is the most common form of primary dementia. It afflicts 1 in 10 people over age 65 and nearly half of all people aged 85 and over. It has been estimated that more than 1,00,000 die of Alzheimer's disease annually, which makes it the fourth leading cause of death in adults, after heart disease, cancer and stroke.

Common Symptoms: Memory loss, Difficulty performing familiar tasks, problems with language, Disorientation to time and place, Poor or decreased judgment, Problems with abstract thinking, Misplacing things, changes in mood or behaviour, changes in personality, loss of initiative, etc.

- **Epilepsy**

Epilepsy is the most common of many severe neurological disorders. But in contrast to other chronic diseases such as diabetes and heart disease, epilepsy carries a heavy burden of stigma that is a major obstacle to its treatment. According to WHO, an estimated 39 million people in the world suffer from epilepsy, but some 39 million of them- almost three out of every four get little help for the condition. In developing countries, 60-90 per cent of people with epilepsy are excluded from treatment. There is thus a huge treatment gap where epilepsy is concerned. To combat epilepsy, education of health workers, patients, and the wider community is essential.

Cantab-paired Associate Learning (Cantab-pal) test: This test was invented by Dr. Barbara Sahakian and Professor Trevor Robbins which detects Alzheimer's disease with 98 per cent accuracy. It distinguishes Alzheimer's sufferers from patients with depression and people without any neuropsychiatric disorder.

Cantab-pal works by flashing patterns and images on the computer screen. Patients have to identify where the image first appeared.

According to Dr. Sahakian, Cantab will be, useful not only for early detection of Alzheimer's disease but could also be used to measure the beneficial effects of current pharmacy ecological treatments such as cholinesterase inhibitors, as well as future drugs, including neuroprotective agents.

The test's sensitivity to Alzheimer's disease is related to the fact that the areas in the brain first affected are those utilized when performing the test.

SARS AND BIRD FLU

Severe Acute Respiratory Syndrome (SARS) was recognized at the end of February 2003. Emerging and re-emerging epidemic diseases pose an on-going threat to global health security. According to Klaus Stohr, a virologist for the WHO, there is nearly conclusive evidence to implicate a type called a coronavirus for SARS. Coronavirus belongs to a family of viruses that can cause among other things, the common cold in humans.

The WHO Specialist's conclusion is based on the fact that out of 55 SARS patients tested, 45 either had the virus in their faeces, or had antibodies to it in their body fluids. The virus has, moreover, been isolated from patients during all stages of the disease.

It is still not clear where the virus first came from but genetic work suggests it is related to mouse hepatitis C, transmissible gastroenteritis in Pigs, and the human coronavirus. Such links add force to the theory that the disease originated in livestock in rural China, where humans and animals live in close contact, and then jumped to humans.

Initially, the epidemiologists believed that the virus spread by the transmission of droplets, that is, through coughing and sneezing. But some cases caused particular alarm because they do not appear to follow a droplet pattern of infection, so new routes of transmission, via air and water, are being examined.

Without knowing the precise transmission routes, it is difficult to contain a disease. As a precautionary step, WHO recommended that all but essential travel to Hong Kong and Guangdong should be postponed. Fortunately, after WHO's alert, health authorities were primed to isolate these cases, and they were able to prevent any subsequent spread. The alert, though, came just too late to prevent an outbreak in Canada.

At the moment only time and labour-intensive laboratory testing can determine if someone is infected with the disease.

American Scientists at the Center for Disease Control and Prevention (CDC), after identifying the new coronavirus, proposed that the virus should be named after a doctor, Carlo Urbani, who first identified the disease and then became a victim. Dr Urbani succumbed to the disease later.

After SARS the world has once been rocked by another pandemic avian havoc. Major affected areas were South-East Asia. Mass culling of birds was also undertaken in South Korea, Vietnam, Japan, Taiwan, China and Pakistan. The disease is caused by the H5N1 avian influenza virus. The World Health Organization (WHO) confirmed that the fatal infection had caused some deaths.

Bird flu or AF is a form of influenza that strikes all birds. The domestic poultry are particularly more prone to it. This is an acute infectious disease of the respiratory and gastro-intestinal tract caused by a strain of influenza virus A. The Type A influenza virus spreads to human beings and other animals through contaminated nasal respiratory and faecal material from infected birds. Bird flue symptoms in humans are fever, cough, sore throat and muscle aches. Other symptoms include eye infection, pneumonia, acute respiratory distress, viral pneumonia and kidney failure. The latest AF outbreak was particularly alarming from the perspective of human health because the causative agent for most of these outbreaks was a highly pathogenic strain, (H5N1) which is deadly to poultry, particularly chickens. Birds that survive infection shed the virus for at least 10 days, orally and through faeces, thus facilitating its spread. H5N1 also has the unique capacity to jump the species barrier. The virus, which was first isolated from terns in South Africa in 1961, mutates rapidly and has the propensity to acquire genes from influenza viruses, affecting other animal species.

FOOD ADULTERATION

The Prevention of Food Adulteration Act, 1954, has been in force since June, 1985, with the objective of ensuring that food articles sold to consumers are pure and wholesome. It also aims at preventing fraud or deception and encouraging fair trade practices. A minimum imprisonment of six months with a minimum fine of Rs. 1,000 is envisaged under the Act for cases of proven adulteration whereas for the cases of adulteration which may render the food injurious to cause death or such harm which may amount to grievous hurt, the punishment may go up to life imprisonment and a fine which shall not be less then Rs. 5,000.

The administration of the Act and the provisions thereunder is the primary responsibility of state government and union territory administration. The Central government lays down broad policies in this regard, carries out the necessary amendments to the Act and rules and advises state governments and union territory administrations in the effective implementation of the programme. For advising the Centre or the states with regard to implementation of the Act, there is a statutory body, namely, Central Committee for Food Standards. The Committee is assisted by various technical sub-committees. The Act is, by and large, implemented by local bodies.

There are four central food laboratories viz. Central Food Laboratory at Central Food Technological Research Institute (CFTRI),

Mysore; Central Food Laboratory at Food Research and Standardisation Laboratory, Ghaziabad; Central Food Laboratory at State Public Health Laboratory Pune and Central Food Laboratory, Kolkata. Samples are sent to these appellate laboratories by courts. Statements of facts contained in the report given by the laboratories are considered to be the final and conclusive evidence.

Food Safety and Standards Authority of India (FSSAI) had notified Rules on 5th August 2011 under FSSA Act 2006 to give guidelines to food industry for hygiene and regulations/ standards for safe and wholesome food for human consumption.

A nationwide project, Food and Drug Capacity Building Project was designed to improve the quality and safety of food and drugs by strengthening the regulatory framework and incorporating components of consumer education with the assistance of World Bank. The project remained in operation from 2003 to 2008 to improve the capacity of laboratories at central and state levels along with other regulatory programme. For this purpose the government of India took nearly Rs.320 crore soft loans from World Bank.

There are 76 food laboratories under the control of state government/local bodies. The samples lifted by food inspectors are sent to these laboratories and on the basis of the reports, prosecutions are launched in courts.

Under joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission has been established to formulate worldwide standards for food. India is also a member of this body. A National Codex Committee has been set up under the Ministry of Health and Family Welfare to formulate the Indian viewpoint on various matters concerning International Food Standards Programme.

NEW INVENTIONS IN THE FIELD OF MEDICINES

1. Nuclear Medicine

In the peaceful use of nuclear science, nuclear medicine has a prominent place. The alpha, beta and gamma radiations from radioactive nucleus have revealed their curative power. Today, Radio-isotopes have become invaluable tools to solve many complex diseases.

Though the use of Radio-isotopes to cure diseases goes back to 1938, its full development took place in the 70s. Nuclear medicine uses the tracer principle which was evolved by George Hevesy for which he got the Nobel prize in 1944. Today, the Positron Emission Tomography has revolutionised the field of nuclear medicine. The main Radio-isotopes used in nuclear medicine include Cobalt-60, Iridium-192, Gold-199, Oxygen -15, Nitrogen-13, Carbon-11, Fluorine-18, Rubidium-82, Copper-62, Gallium-68, etc. They are used not only for curative purpose, but also for scanning the body. Cabolt-60, Iridium-192, and Gold-199 have been used to cure cancer. Iodine-131 is being used to cure thyroid disorders.

2. Chronotherapy

Chronotherapy is relatively a new field in bio-medical science in which delivering the right therapy at the right time to optimize medical treatment and to reduce the side effects of the medicine. With this aim, chronologists are working to understand the mysteries of the human biological clock (circadian rhythm) and are producing substantial evidence of how synchronizing treatment of chronotherapy (timing treatment according to body's natural rhythm) may make surgery, radiation and drug therapy more effective, significantly reducing side effects and even prolonging life.

3. Blood disease with GM stem cells

Two major-technical obstacles that currently limit the success of gene therapy for human red blood cell diseases such as beta-thalassemia and sickle cell disease have been overcome by researchers at the St. Jude Children's Research Hospital.

The team overcame the obstacle passed by the large number of defective hematopoietic stem cells (HSCs) producing faulty red blood cells in beta-thalassemia or sickle cell disease. The large numbers of defective HSCs thwart attempts by gene therapy to reverse the disease. HSCs are parent cells in the bone marrow that give rise to blood cells. The researchers also performed the difficult task of integrating genes into an HSCs own DNA so the HSCs function normally.

The results offer promise for developing gene therapy to treat blood diseases in humans caused by defective haemoglobin i.e. haemoglobin that either lacks a critical protein called beta globin

or that contains a mutated form of the protein.

Haemoglobin is the oxygen carrying protein in red blood cells. Replacing red blood cells that carry defective haemoglobin with red cells that carry defective haemoglobin with red cells that have normal haemoglobin is a potential strategy for curing these disorders.

Beta thallassemia (Cooley's anaemia) occurs when the haemoglobin molecule lacks the beta-globin molecule that is part of the haemoglobin molecule. In sickle cell disease, an abnormal gene for beta-globin causes haemoglobin molecules in the red blood cell to dump together and distort the cell into the shape of a sickle. Instead of flowing freely, sickle-shaped red cells sludge and block blood vessels. This cut off of blood flow can cause pain, stroke, leg ulcers, bone damage and other medical problems.

The researchers chose beta-thalassemia and sickle cells diseases as targets for their gene therapy study because both diseases could potentially be treated by modifying HSCs with normal genes for gamma-globins, which is usually produced only during foetal life.

4. New Technique for Regenerating Organs

An Indian doctor has achieved a major breakthrough by developing a technique for regeneration of organs and tissue using cells taken from the patients themselves. The technique has recently been granted patent by the U.S. patent and trade mark office. The technique is expected to revolutionize medical science as it could do away with organ and tissue transplants and thus avoid the problems associated with them. The major advantage of this new technique is that no donor would be anymore required to replace diseased organs. Also, as the new tissues and organs would be formed within the body using its own cells, there would be no problem of acceptance of foreign bodies, which had been a major problem associated with transplants. In addition, unlike transplant surgeries, no post operative treatment by expensive immune suppressant drugs would be required.

5. Artificial Hearts

A Massachusetts based Abiomed Company has proposed for production of artificial heart named Abiocor and Jarvik 2000. The development of microprocessors bio-goods, motors and batteries have made the task easy. The pumping mechanism will be done by motors and the microprocessors will maintain the blood flow. The patients using Jarvik 2000 will have to bear a belt to reactivate the battery. The battery will be attached to a plug which will provide energy to the heart through wires. Abiocore uses a better technique where wires are not needed. It uses a coil and a battery in the stomach, which will receive the energy from outer battery by radio waves. Scientists contemplate it to be a substitute for ventricle.

FORENSIC TOOLS

1. Narco Analysis

This is the tool of modern forensics to catch the culprits and trace the criminals and decipher their modus operandi by administering hypnotics or similar drugs into the suspects. In the Narco Analysis Test, the subject's imagination is neutralised by making him semi-conscious. In this state, it becomes difficult for him to lie and his answers would be restricted to facts he is already aware of. Experts inject a hypnotic like Sodium Pentothal or Sodium Amytal and the subject which is put in a state of Hypnotism is not in a position to speak up on his own but can answer specific but simple questions after giving some suggestions. This test is of great help in tracing a crime and finding some evidence, where no primary evidence is available.

Truth serum is a drug used in narco-analysis that cause a person to become uninhibited and talkative, but they do not guarantee the veracity of the subject's statement. People who are under the influence of truth serums enter a hypnotic state and speak freely about anxieties or painful memories. The subject's imagination is neutralised when semi-conscious, making it difficult for him/her to lie and his/her answers would be restricted to facts of which he/she is aware.

Limitation: Such tests generally don't have legal validity as confessions made by a semi-conscious person are not admissible in court. It states that subjects under a semi-conscious state do not have the mind set to properly answer any questions, while some other courts openly accept them as evidence.

2. Polygraph

A polygraph (commonly known as a lie

detector) is a device that measures and records several physiological variables such as blood pressure, heart rate, respiration and skin conductivity while the subject is asked a series of questions. The measurements are posited to be indicators of anxiety that accompanies the telling of lies. Thus, measured anxiety is equated with telling untruths. However, if the subject exhibits anxiety for other reasons, or can control his anxiety level voluntarily, a measured response can result in unreliable conclusions. A polygraph test is also questionably used as a psycho-physiological detection of deception (PDD) examination.

Limitation: Today, polygraph examiners use two types of instrumentation, analog and computerized. While some people believe that polygraph tests are reliable, there is little scientific evidence to buttress this claim. For example, while some claim the test to be accurate in 70% - 90% of the cases, critics charge that rather than a "test, the method amounts to an inherently unstandardizable interrogation technique whose accuracy cannot be established.

3. Brain Fingerprinting

Brain fingerprinting, invented by Dr. Lawrence Farwell, is a technique that measures recognition of familiar stimuli by measuring electrical brain wave responses to words, phrases, or pictures that are presented on a computer screen. The theory is that the suspect's reaction to the details of an event or activity will reflect if the suspect had prior knowledge of the event or activity. This test uses the Memory and Encoding Related Multifaceted Electroencephalographic Response to detect familiarity reaction.

Ethical Consideration: The electrical potential of the human brain with relation to specific thoughts and feelings seem to some people to be highly invasive. However, such screening procedures might potentially be much more effective than polygraph screening, which has never been shown to have prevented an act of espionage.

TELEMEDICINE

Telemedicine

Telemedicine involves transfer of medical information online and in real-time for use in diagnosis, treatment, and education across distances. The concept of telemedicine was introduced more than 30 years ago through the use of telephone, facsimile machine, and slow-scan images. However, the enabling technology has grown considerably in the past decade. The term telemedicine, in short refers to the utilization of telecommunication technology for medical diagnosis, treatment and patient care.

Areas of Application

Telemedicine enables a physician or specialist at one site to deliver health care, diagnose patients, give intra-operative assistance, provide therapy, or consult with another physician or paramedical personnel at a remote site. Telemedicine system consists of customized medical software integrated with computer hardware, along with medical diagnostic instruments connected to the commercial VSAT (Very Small Aperture Terminal) at each location or fibre optics.

Although, telemedicine could potentially affect all medical specialties, the greatest current applications are found in radiology, pathology, cardiology and medical education. Perhaps the greatest impact of telemedicine may be in fulfilling its promise to improve the quality, increase the efficiency, and expand the access of the healthcare delivery system to the rural population and developing countries.

Telemedicine finds application in a wide area. Given below are areas of application and the advantages accrued thereof.

Specialist consultations between two or more hospitals: Advantage to patients due to higher accuracy of diagnosis and treatment. Leads to shorter hospital stay, faster turnover, increased availability of hospital beds and conservation of medical assets.

Opinions on special investigations: Secondary medical centres can send investigations like ECGs, EEGS, TMTs, ultrasound/CAT/MRI scans, etc for reporting/ opinions to specialists at tertiary centres. This would conserve scarce resources, in this case, the specialists can lead to their better utilization.

Specialist opinions to GPs at small towns and villages: A 'Telemed Unit once made available to a general practitioner (GP) at a

remote site would connect him and hundreds like him to a Central Specialist Centre (CSC). The CSC would provide these GPs with 24 hrs 7 days a week specialist consultancy. This would result in a good number of patients being treated locally, though being monitored by specialists, remotely. Franchising of such units would be a viable business proposition.

Virtual Patient Visits: Relatives can 'virtually visit their near and dear ones admitted to hospitals 1000s of miles away with the help of video conferencing. This would be a tremendous psychological boost for the patient and could speed up his recovery.

Medical Tourism: It is the Buzz word in corporate hospitals today. Patients from far off countries can avail of superb, immediate treatment at less then half to one sixth the cost that they would have paid in their own country.

Chronic patients monitored from home: Chronic patients can be monitored from home regularly by remote consultations, cutting down on trips to distant hospitals. This methodology applies well to certain cardiovascular, respiratory, diabetic, renal, psychiatric and dermatological cases.

Treatment of patients in inaccessible areas: Patients in inaccessible areas like mountains, ships at seas, islands when cut off due to weather conditions or natural disasters can be treated and monitored till they get access to a hospital.

Treatment of casualties in disaster areas: Telemedicine portable units can be setup at disaster areas in a few hours to assist local doctors in receiving specialist opinions and advice for rational evacuation of casualties.

These are just a few of the areas where telemedicine is utilized today.

DEVELOPMENT IN INDIA

The concept of telemedicine, started about ten years ago in India on a pilot basis, has matured onto the next level. Major hospital groups are now looking at significantly expanding their centres not just in India but also in neighbouring countries. The first telemedicine project in the country was set up by the Apollo Hospitals group in the village of Aragonda in Andhra Pradesh in 1999. Apollo Hospitals, which now has close to 150 centres in India, Bangladesh, Maldives, Sri Lanka and Kazakhstan, is targeting to have 500-700 locations in the next 18-24 months.

ISRO's Network: ISRO's satellite based Telemedicine network, which started in 2001 on an experimental basis, was aimed at linking remote/rural district hospitals with super-specialty hospitals in major cities via INSAT. While ISRO provides software, hardware and communication equipment as well as satellite bandwidth, the specialty hospitals provide infrastructure, manpower and maintain the system. There are currently estimated 350-400 hospitals connected by telemedicine. On the ISRO network alone, there are 170, of which around 35 are specialty hospitals and the rest remote centres.

ISRO's Telemedicine network further expanded with the signing of MOU on May 16, 2006 with four specialty hospitals - Manipal Hospital, Bangalore; Sir Ganga Ram Hospital, New Delhi; Madras Diabetic Research Foundation, Chennai and Dr Venkatrao Dawle Medical Foundation, Ambajogai (Maharashtra).

ISRO's telemedicine programme is an example of societal orientation of Indian space programme and with several private specialty hospitals besides state governments and NGOs showing keen interest in establishing the telemedicine network, augurs well to the cause of extending quality healthcare to the rural population. Efforts are also being made by ISRO to include telemedicine through Village Resource Centres (VRC) which are being set up in association with NGOs, trusts and state and central agencies.

Providing healthcare to India's over one billion population of which about 75 per cent live in villages, is a formidable task. About 75 per cent of the doctors practice in urban areas and 23 per cent in semi-urban areas. This leaves just 2 per cent of the qualified doctors, who are attached to about 23,000 primary health and 3000 community health centres, to attend to 70 per cent of the population living in villages.

Telemedicine initiatives at ISRO have been broadly divided into the following areas:

- Providing Telemedicine Technology & connectivity between remote/rural

hospital and Super Speciality Hospital for Teleconsultation, Treatment & Training of doctors & paramedics.

- Providing the Technology & connectivity for Continuing Medical Education (CME) between Medical Colleges & Post Graduate Medical Institutions/ Hospitals.
- Providing Technology & connectivity for Mobile Telemedicine units for rural health camps especially in the areas of ophthalmology and community health.
- Providing technology and connectivity for Disaster Management Support and Relief.

As telemedicine technologies and processes gradually mature, the extent of medical specialties where telemedicine technologies could prove clinically useful should expand. Indeed, reports of telemedicine implementation are appearing in orthopaedics, dermatology, psychiatry, oncology, neurology, pediatrics, internal medicine, ophthalmology and surgery.

NATIONAL RURAL HEALTH MISSION

Recognizing the importance of Health in the process of economic and social development and improving the quality of life of our citizens, the Government of India has launched the National Rural Health Mission to carry out necessary architectural correction in the basic health care delivery system.

The Mission adopts a synergistic approach by relating health to determinants of good health viz. segments of nutrition, sanitation, hygiene and safe drinking water. It also aims at mainstreaming the Indian systems of medicine to facilitate health care.

National Rural Health Mission was launched on 12th April, 2005 with an objective to provide effective healthcare to the rural population, the disadvantaged groups, including women and children by improving access, enabling community ownership, strengthening public health systems for efficient service delivery, enhancing equity and accountability and promoting decentralization.

The scheme proposes a number of new mechanisms for healthcare delivery, including training local residents as Accredited Social Health Activists (ASHA) and the Janani Surakshay Yojana (motherhood protection programme). It also aims at improving hygiene and sanitation infrastructure. It is the most ambitious rural health initiative ever.

The mission has a special focus on 18 states Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Himachal Pradesh, Jharkhand, Jammu and Kashmir, Manipur, Mizoram, Meghalaya, Madhya Pradesh, Nagaland, Orissa, Rajasthan, Sikkim, Tripura, Uttarakhand and Uttar Pradesh.

Goals of NRHM:

a) Reduction in Infant Mortality Rate (IMR) and Maternal Mortality Ratio (MMR).

b) Universal access to public health services such as Women's health, child health, water, sanitation &hygiene, immunization, and Nutrition

c) Prevention and control of communicable and non-communicable diseases, including locally endemic diseases.

d) Access to integrated comprehensive primary healthcare.

e) Population stabilization, gender and demographic balance.

f) Revitalize local health traditions and mainstream AYUSH.

g) Promotion of healthy life styles.

Salient features of NRHM:

a) Innovation in Human Resource Management

Promote access to improved healthcare at household level through the Accredited Social Health Activist (ASHA). ASHA would act as a bridge between the Auxiliary Nurse and the village Midwives and be accountable to the Panchayat. ASHA would facilitate in the implementation of the Village Health Plan along with Anganwadi workers, ANM, functionaries of other Departments, and Self Help Group members, under the leadership of the Village Health Committee of the Panchayat.

b) Strengthening Public Health Delivery in India

New concepts of Indian Public Health Standards have been introduced. They are a set

of standards envisaged to improve the quality of healthcare delivery in the country under the National Rural Health Mission.

c) Strengthening PHCs

Mission aims at Strengthening PHC for quality preventive, promotive, curative, and supervisory and Outreach services through adequate and regular supply of essential quality drugs and equipment (including Supply of Auto Disable Syringes for immunization) to PHCs. Provision of 24 hour service in 50% PHCs by addressing shortage of doctors, especially in high focus States, through mainstreaming AYUSH manpower.

d) Strengthening CHCs

Infrastructure strengthening of CHCs by implementation of IPHS standards which includes Promotion of Stakeholder Committees (Rogi Kalyan Samitis) for hospital management and developing standards of services and costs in hospital care.

e) Decentralized Planning

This includes the District Health Mission at the District level and the State Health Mission at the state level. District Health Plan would be a reflection of synergy between Village Health Plans, State and National priorities for Health, Water Supply, Sanitation and Nutrition. It also includes involvement of PRIs in planning process to improve access of facilities.

f) Strengthening Disease Control Mechanisms

National Disease Control Programmes for Malaria, TB, Kala Azar, Filaria, Blindness & Iodine Deficiency and Integrated Disease Surveillance Programme has been integrated under the Mission, for improved programme delivery and new initiatives have been launched for control of Non Communicable Diseases. Further disease surveillance system at village level would be strengthened. Supply of generic drugs (both AYUSH & Allopathic) for common ailments at village, SC, PHC/CHC level will also be included.

NATIONAL URBAN HEALTH MISSION

The Union Cabinet gave its approval to launch a National Urban Health Mission (NUHM) as a new sub-mission under the over-arching National Health Mission (NHM). Under the Scheme the following proposals have been approved:

a) One Urban Primary Health Centre (U-PHC) for every fifty to sixty thousand population.

b) One Urban Community Health Centre (U-CHC) for five to six U-PHCs in big cities.

c) One Auxiliary Nursing Midwives (ANM) for 10,000 population.

Positive outcomes of NRHM:

National Rural Health Mission	Proposed Goal	Achievements:
	• MMR: 100/100,000 Live Births • IMR: 30/1000 Live Births • TFR: 2.1	MMR: 301-SRS (RGI) (2002) 254-SRS (RGI) (2005) 212-SRS (RGI) (2008) IMR: 60-SRS (RGI) (2003) 57-SRS (RGI) (2006) 47-SRS (RGI) (2010) U5 MR: 85-SRS (RGI) (2000) 77-SRS (RGi) (2005) 64-SRS (RGI) (2009) • **Institutional Delivery:** ❖ 72.9%-CES (2009) • **Complete Immunization:** ❖ 61%-CES (2009) • **Total Fertility Rate:** ❖ 3-SRS-(RGI) (2003) ❖ 2.6-SRS-(RGI)(2008)

d) One Accredited Social Health Activist ASHA (community link worker) for 200 to 500 households.

The estimated cost of NUHM for 5 years period is Rs.22,507 crore with the Central Government share of Rs.16,955 crore. Centre-State funding pattern will be 75:25 except for North Eastern states and other special category states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand for whom the funding pattern will be 90:10.

The scheme will focus on primary healthcare needs of the urban poor. This Mission will be implemented in 779 cities and towns with more than 50,000 population and cover about 7.75 crore people.

The interventions under the sub-mission will result in

I. Reduction in Infant Mortality Rate (IMR).
II. Reduction in Maternal Mortality Ratio (MMR).
III. Universal access to reproductive health care.
IV. Convergence of all health related interventions.

The existing institutional mechanism and management systems created and functioning under NRHM will be strengthened to meet the needs of NUHM. City-wise implementation plans will be prepared based on baseline survey and felt needs. Urban local bodies will be fully involved in implementation of the scheme.

NUHM aims to improve the health status of the urban population in general, particularly the poor and other disadvantaged sections by facilitating equitable access to quality health care, through a revamped primary public health care system, targeted outreach services and involvement of the community and urban local bodies.

NATIONAL HEALTH POLICY 2002

The National Health Policy-2002 (NHP-2002) was cleared by the Union Cabinet in May 2002. This is the second such policy adopted by the Government after a gap of 19 years. The National Health Policy-2002 gave prime importance to ensure a more equitable access to health services across the social and geographical expanse of the country. It calls for a strong primary health network in rural India. Emphasis has been given to increase the aggregate public health investment through a substantially increased contribution by the Central Government. Priority has been given to preventive and curative initiatives at the primary health level through increased sectoral share of allocation.

The main objective of this policy is to achieve an acceptable standard of good health amongst the general population of the country. The approach would be to increase access to the decentralized public health system by establishing new infrastructure in deficient areas, and by upgrading the infrastructure in the existing institutions. The contribution of the private sector in providing health services would be much enhanced, particularly for the population group which can afford to pay for services. Primacy will be given to preventive and first-line curative initiatives at the primary health level through increased sectoral share of allocation. Emphasis will be laid on rational use of drugs within the allopathic system.

The policy plannned to increase health sector expenditure to 6 per cent of GDP, with 2 per cent of GDP being contributed as public health investment, by the year 2010. The State Governments would also need to increase the commitment to the health sector. In the first phase, by 2005, they would be expected to increase the commitment of their resources to 7 per cent of the Budget; and, in the second phase, by 2010, to increase it to 8 per cent of the Budget. With the stepping up of the public health investment, the Central Government's contribution would rise to 25 per cent from the existing 15 per cent by 2010.

The NHP-2002 sets out an increased allocation of 55 per cent of the total public health investment for the primary health sector; the secondary and tertiary health sectors being targeted for 35 per cent and 10 per cent respectively.

Delivery of National Public Health Programmes: The NHP-2002 envisages the gradual convergence of all health programmes under a single field administration. Vertical programmes for control of major diseases like TB, Malaria, HIV/AIDS, as also the RCH and Universal Immunization Programmes, would need to be continued till moderate success is achieved.

Public Health Infrastructure: The Policy envisages kick-starting the revival of the Primary Health System by providing some essential drugs under Central Government funding through the decentralized health system.

Extending Public Health Services: NHP-2002 envisages that in the context of the availability and spread of allopathic graduates in their jurisdiction, State Governments should consider the need for expanding the pool of medical practitioners; to include a cadre of licentiates of medical practice and also practitioners of Indian Systems of Medicine and Homoeopathy. Simple services / procedures can be provided by such practitioners even outside their disciplines, as part of the basic primary health services in under-served areas.

Role of Local Self-government: NHP-2002 lays great emphasis upon the implementation of public health programmes through local self-government institutions. The structure of the national disease control programmes will have specific components for implementation through such entities.

Use of Generic Drugs and Vaccines: The 2002 policy emphasizes the need for basing heatment procedure in both the public and private domain, on a limited number of essential drugs of a generic nature. This is a pre-requisite for cost-effective public healthcare. In the public health system, this would be enforced by prohibiting the use of proprietary drugs, except in special circumstances.

Urban Health: NHP-2002 envisages the setting up of an organised urban primary health care structure. Since the physical features of urban settings are different from those in rural areas, the policy envisages the adoption of appropriate population norms for the urban public health infrastructure. The structure conceived under NHP-2002 is a two-tiered one: the primary centre is seen as the first-tier, covering a population of one lakh, with a dispensary providing an OPD facility and essential drugs, to enable access to all the national health programmes; and a second-tier of the urban health organisation at the level of the Government general hospital, where reference is made from the primary centre.

Mental Health: NHP - 2002 envisages a network of decentralised mental health services for ameliorating the more common categories of disorders. The programme outline for such a disease would involve the diagnosis of common disorders, and the prescription of common therapeutic drugs, by general duty medical staff.

Information, Education and Communication: NHP-2002 envisages an IEC policy, which maximizes the dissemination of information to those population groups which cannot be effectively approached by using only the mass media. The focus would therefore be on the inter-personal communication of information and on folk and other traditional media to bring about behavioural change.

Health Research: This Policy envisages an increase in Government-funded health research to a level of 1 per cent of the total health spending by 2005; and thereafter, up to 2 per cent by 2010. Domestic medical research would be focused on new therapeutic drugs and vaccines for tropical diseases, such as TB and Malaria, as also on the sub-types of HIV / AIDS prevalent in the country.

National Disease Surveillance Network: This Policy envisages the full operationalization of an integrated disease control network from the lowest rung of public health administration to the Central Government, by 2005. The programme for setting up this network will include components relating to the installation of data-base handling hardware; IT inter-connectivity between different tiers of the network; and in-house training for data collection and interpretation for undertaking timely and effective response.

Health Statistics: The Policy envisages the completion of baseline estimates for the incidence of the common diseases - TB, Malaria, and Blindness - by 2005. The policy also recognizes the need to establish, in a longer time-frame, baseline estimates for non-communicable diseases, like CVD, Cancer, Diabetes; and accidental injuries, and communicable diseases, like Hepatitis and JE.

Women's Health: The Policy notes that women, along with other under-privileged groups, are significantly handicapped due to a disproportionately low access to health care. The various Policy recommendations of NHP-2002, in regard to the expansion of primary health sector infrastructure, will facilitate the increased access of women to basic health care.

Medical Ethics: NHP - 2002 envisages that, in order to ensure that the common patient is not subjected to irrational or profit-driven medical regimes, a contemporary code of ethics be notified and rigorously implemented by the Medical Council of India.

Environmental and Occupational Health: This Policy envisages that the independently - stated policies and programmes of the environment -related sectors be smoothly interfaced with the policies and the programmes of the health sector, in order to reduce the health risk to the citizens and the consequential disease burden.

Providing medical facilities to users from overseas: To capitalize on the comparative cost advantage enjoyed by domestic health facilities in the secondary and tertiary sectors, NHP-2002 strongly encourages the providing of such health services on a payment basis to service seekers from overseas.

Impact of globalisation on the health sector: The Policy takes into account the serious apprehension, expressed by several health experts, of the possible threat to health security in the post-TRIPS era, as a result of a sharp increase in the prices of drugs and vaccines. To protect the citizens of the country from such a threat, this policy envisages a national patent regime for the future, which, while being consistent with TRIPS, avails of all opportunities to secure for the country, under its patent laws, affordable access to the latest medical and other therapeutic discoveries. The policy also sets out that the Government will bring to bear its full influence in all international fora - UN, WHO, WTO, etc. - to secure commitments on the part of the Nations of the Globe, to lighten the restrictive features of TRIPS in its application to the healthcare sector.

❖❖❖

ELECTRONICS & COMPUTERS

ELECTRONICS SECTOR IN INDIA

India is one of the fastest growing markets of electronics in the world. There is potential to develop the Electronics System Design & Manufacturing (ESDM) sector to meet our domestic demand as well as to use the capabilities so created to successfully export ESDM products from the country.

Production of electronic equipment and components has come a long way since the days of radio receivers in 1940s. Electronics industry in India has grown with domestic demand as a result of import substitution efforts. India embarked on its Electronics journey around 1965 with an orientation towards space and defence technologies. This was rigidly controlled and initiated by the Government. This was followed by developments in consumer electronics mainly with Transistor radios, Black & White TVs, Calculators and other audio products. Colour Televisions soon followed.

In order to keep pace with developments in the international scene and also considering the increasing importance of electronics for diversified applications, the Department of Electronics was set up by the Government of India in 1971. Since then, the department has been coordinating development of electronics in India and reviewing constantly the growth achieved in the industrial front and in the R & D capabilities.

In 1982, which was a significant year in the history of television in India, the government allowed thousands of colour TV sets to be imported into the country to coincide with the broadcast of Asian Games in New Delhi. 1985 saw the advent of Computers and Telephone exchanges, which were succeeded by Digital Exchanges in 1988. The period between 1984 and 1990 was the golden period for electronics during which the industry witnessed continuous and rapid growth.

After the software boom in mid 1990s India's focus shifted to software. Moreover the steep fall in custom tariffs made the hardware sector suddenly vulnerable to international competition. In 1997 the ITA agreement was signed at the WTO where India committed itself to total elimination of all customs duties on IT hardware in the near future.

In recent years the electronic industry is growing rapidly. It is currently worth $75 Billion but according to estimates, has the potential to reach $ 400 billion by 2020. The largest segment is the consumer electronics segment and the largest export segment is of components. Electronics plays a catalytic role in increasing production and productivity in key sectors like power, coal, oil, railways, communication and process industries.

TECHNOLOGY DEVELOPMENT

The Department of Electronics supports and funds technology development through its councils set up in various fields namely the Technology Development Council (TDC) for areas like components, computer communication and instrumentation, etc., the National Radar Council (NRC) for radars, navigational aids, sonar, underwater electronics systems, laser and infra-red based detection/ ranging systems, National Microelectronics Council (NMC) for design and production technology of LSI/VLSI, ASICs, etc. Electronic Materials Development Council (EMDC) for materials, including special ceramics, high purity metals, gas, etc., and the National Photonics Council (NPC) for photonic related areas covering also electronics devices, optical data storage switching, imaging, vision informatics, etc. These councils also provide inter-ministerial forum for overall development, including generation of production capabilities in their respective areas. Some of the completed projects under these programmes have made a definite impact on the R & D capabilities of the country.

Scientific Projects in Specific Areas

Centre for Development of Advanced Computing (C-DAC) has developed a software under India's IT Ministry and Israel's FTK Technologies that covers ten scripts and 3000 characters and supports Windows, MAC and Linux.

'Lekhika 2007'-a software application is expected to enable masses in India, who do not know English, to gain computer skills in their own language, thanks to its user-friendly, comprehensive, cost-efficient format. The software costing between Rs 2500 and Rs 3000 rupees currently supports Hindi, Bengali, Telugu, Marathi, Tamil, Gujarati, Kannada, Malayalam, Urdu and Punjabi, and soon it would include all the officially recognized Indian languages.

Time bound projects in specific areas are being implemented through separate scientific societies like Centre for Development of Advanced computing (C-DAC) which has developed 256 nodes PARAM parallel super computer of computing power IG flops/7500 MIPs and Centre for Materials for Electronics Technology (C-MET) to establish technology for a range of electronic materials. Other funded projects like Fibre Optics System Development, Knowledge Based computer System (KBCS), Advanced Technology Programme on Computer Networking (ERNET), development of high-power devices. etc., are making satisfactory progress. To encourage application-oriented research, design and development, Electronics Research and Development Centre (ER & CDs) and Rural Electronics Technology Centre (RETC), Society for Applied Microwave Electronics Engineering and Research (SAMEER), National Centre for Software Technology, etc., are also being funded to strengthen respective R & D activities.

The Department has launched a Standardization, Testing and Quality Control (STQC) Programme for healthy growth of the industry. Equipment Certification schemes are operational covering television receivers and personal computers, including allied peripherals. STQC carries out IEC quality assessment system for electronic components (IECQ) in its role of National Supervisory Inspectorate (NSI).

There has been a radical transformation in the character of electronics industry in India since the development of point contact transistors in 1947-48 which laid the foundation of micro-electronics.

Micro-electronics in the country began appearing around 1970, since then it has made a remarkable progress in various fields. Innumerable applications have been successfully developed and used in industrial, scientific and other areas.

The manufacture of integrated circuits (ICs) started in the country in 1971 when Bharat Electronics Limited (BEL) fabricated the TIL 7420 IC with the knowhow developed by Tata Institute of Fundamental Research (TIFR). The IC produced by BEL so far has SSI/MSI levels of complexity. Besides, it has fabricated a prototype watch chip. In the next few years it proposes to manufacture microprocessors and memory chips, using, RCA's technology.

With the trial production of the pulse dialer chips by the public sector Semiconductor Complex Limited (SCL) in March 1984, the country entered the era of large scale integrated circuits/very large scale integrated circuits. SCL has developed the 32 KHZ clock chip and two kinds of semi-customs gate array circuits for alarm enunciator for Bharat Heavy Electricals Limited (BHEL) and KELTRON. It has stated the design of an Electrically Erasable Programme Read Only Memory (EEPROM) in collaboration with the AM Santa Clara, USA. SCL would also undertake manufacture of a broad range of standard LSIs, including calculator chips, telecom chips, microprocessors and speech synthesizers.

ELECTRONICS IN THE SERVICE OF SOCIETY

Electronics is a knowledge intensive industry. It is a dynamic industry and it is also a global industry. Indian electronics industry is a little more than 40 years old. Although the numbers by themselves appear to be quite impressive when viewed in isolation, if we look at it from the global point of view we find that we have miles to go. The Indian electronics industry constitutes less than 1 per cent of the global electronics industry. On the other hand, India has the potential of emerging as a global player.

Electronics therefore is vital in the context of tackling the immediate national problems. From the long term point of view also, electronics has a tremendous potential to improve the quality of the people, for instance, the electronic media can be an effective method of eliminating illiteracy in rural areas, bringing concepts of public hygiene and improving the quality of life of the women, etc. Department of Electronics had been engaged in a programme called Vivek Darpan which started in May, 1990 in which a colour TV set with a VCP called Sanghamitra was placed in different villages and programmes were shown regularly which were aimed at removal of illiteracy, advice to women about public hygiene, etc. Apart from the socially relevant aspects, a significant impact of electronics is its employment potential especially for women.

Electronics is also important in the concept of planned and balanced regional development. This is because it is a relatively footloose industry and can be located in different parts of the country.

It is therefore obvious that electronics is a sector of industry which is important in the national development effort and which can significantly contribute to the improvement of the quality of life of the people in our country.

Competitive Advantages: When we talk of competing in the international market, we need to consider major factors that the important for a nation to develop competitive advantage. Prof. Michael Porter had identified a "diamond" of four factors, namely:

(i) Factoral advantages which will include factors like low cost labour, raw materials etc.

(ii) Intense competition between the indigenous players in the same sector.

(iii) Availability of related industries to provide the necessary infrastructural support, and family,

(iv) The demand of the consumers.

Therefore we should approach self reliance in the electronics sector so far as India is concerned making the best of the advantages that it has and emerge as a global player.

Import Intensity: When we look at the competitive advantage of the Indian electronics industry we find that our industry has got many weaknesses. Whereas generally in other industries we have started from the lower end of raw materials and components and then gone on to the finished products, in the case of electronics industry we started from the other end that is from equipment and then worked in the reverse direction. As a result there is a high degree of import intensity in the Indian Industry today. If we view the import intensity from the point of view of the raw materials we find that the import dependence in other sectors of industry may be 10% whereas it is 50 to 80% so far as electronics is concerned.

The major imports in this sector broadly fall into the following categories:

(i) Direct import of finished equipment by user Ministries/ Departments such as Defence, Communications, Railways, Civil aviation, etc.

(ii) Imports of equipment by small actual users like hospitals, R & D organisations, educational institutions, etc.

(iii) Imports in the form of personal baggage.

(iv) Imports by the local electronics industry for production activities, both for local consumption as well as for exports.

Necessary Imports: The imports under the first three categories can be minimized only through increasing the local production base. This needs considerable imported items under the following requirements.

(a) Import of capital goods, test equipments, tools, etc. for production of electronic equipment and components.

(b) Import of electronic components, mechanical hardware items, etc. by equipment manufacturers.

(c) Import of raw materials and parts by electronic component manufacturers.

(d) Import of components, sub assemblies parts, etc. by export oriented production units.

Emphasis on Exports: Due to rapid changes in technology and new products being

introduced in the international and domestic market, it may not be possible to cut down the import content in the Indian electronics products drastically.

USA and UK continues to be major markets for the IT software and services exports. Markets across Continental Europe and the Asia Pacific are also witnessing significant year-on-year growth. This trend towards a broader geographic market exposure is positive for the industry, not only as de-risking measure but also as a means of accelerating growth by tapping new markets.

Indigenization: While the above analysis may give us a macro picture about the overall balance in foreign exchange and the degree of indigenization the first area we are concentrating is the indigenous R & D. It has been found that there is a tremendous time lag between the development of the technology in the laboratory and its application. An attempt is being made to reduce this time to the market by bringing up this issue in a forum comprising the industries, financial institutions, institutions like IITs as well s the Department of Electronics.

ELECTRONICS IN HEALTHCARE AND REHABILITATION

The integrated Linear Accelerator (LINAC) development programme, which was initiated in 1991, is now in full operation and is designed to put our country to the forefront of technology for cancer radiation therapy and treatment planning. These LINACs have been fabricated with full participation of five major public sector undertakings who are jointly taking up the knowhow for LINAC for commercial production. The new LINAC prototypes are an update on first prototype which was installed at PGIMER, Chandigarh and several advance features have been incorporated into the system.

Project on development of a state of the 3-dimensional treatment planning system for cancer radiotherapy has been initiated. The project is being implemented with full participation of a leading treatment planning system manufacturer in the private sector and will be based on the advanced parallel processor technology of C-DAC.

The technology development programme for electronics in healthcare has been progressing on target. First prototype of computer based communication aid for the spastics has undergone field trials with extremely encouraging feedback from the Spastics Society of India. A new project has been initiated on development of thin film bio-medical transducers. The project will result in products which have a large demand within the country.

ELECTRONICS IN AGRICULTURE AND AGRO BASED INDUSTRIES

Microprocessor based drip irrigation and control system is under field trial stage and will be evaluated over 2-3 crop-cycles. Short term trials of soil salinity mapping system using inductive electro-magnetic principle have been done and efforts are underway to fabricate a prototype for extended field trials.

The programme on application of Electronics in the Industry is being implemented at AMTRON, Guwahati and MAEP Centre, Kolkata. AMTRON has developed the VERMIAC range of instrumentation based on distributed computer architecture and monitors four vital processing stages viz. withering, rolling, fermentation and drying. The system is installed at Hunwal Tea Estate near Jorhat. MAEP Kolkata centre has developed an application of electronic control and instrumentation system for Jute industry has been initiated. The objective of the project is to develop electronic systems and facilities for modernising jute industry to make it competitive in national and international markets.

Various elements of the project are as follows:

(i) Modification of existing electronic instruments/systems available for cotton textile for application to jute.

(ii) Development of on-line and off-line instruments/systems for Jute industry.

(iii) Setting up of infrastructure for repair and maintenance of electronic instruments and training of mill personnel.

SOCIO-ELECTRONICS PROGRAMME

The scheme for training of medical and para-medical personnel was taken up with a view to provide effective support in the repair and maintenance of Electro-medical equipment.

Advanced training programme for the para medical staff has also been worked out and such training programmes are being conducted through IHRDE, Trivandrum.

Vivek Darpan: Project Vivek Darpan (PVD) is designed to demonstrate and propagate the use of the audio visual media as a more cost effective method for dissemination of socio-economic information/knowledge in rural areas as compared to traditional methods/ media. Several pilot projects have been initiated in carefully selected villages to show that these mediums can strengthen and help in taking knowledge, education and developmental messages to rural people, particularly women. This medium is used as an aid for communication in programmes of rural development, family welfare and women's development. The Department of Electronics as a scientific department has funded a few early pilot projects only for establishing cost-effectiveness of TV-UVP medium. The objectives of the Project Vivek Darpan are:

(1) Effective dissemination of developmental motivation and knowledge/skills for rural folk, especially women using audio-visual media as multi-user, multi-tasking systems.

(2) Effectively supplementing the post-literacy development efforts for rural adults.

(3) Achieve favourable and sustainable impact in the areas of family planning, health and hygiene improvement, social awareness and productivity improvement.

(4) Cause extensive replication/spread in thousands of villages by convincing other central and state government agencies/ NGOs on the cost-effectiveness of this media.

The NGOs now implementing Project Vivek Darpan in 105 Villages are holding one hour sessions for 5 different set of groups eg. children, youth, women, general audiences and farmers every day.

NATIONAL POLICY ON ELECTRONICS 2012

The National Policy of Electronics envisions creating a globally competitive Electronics Systems and Design Manufacturing (ESDM) industry, including nano-electronics to meet the country`s needs and serve the international market. The strategies include setting up of a National Electronics Mission with industry participation and renaming the Department of Information Technology as Department of Electronics and Information Technology (Deity).

The policy is expected to create an indigenous manufacturing eco-system for electronics in the country. It will foster the manufacturing of indigenously designed and manufactured chips creating a more cyber secure ecosystem in the country. It will enable India to tap the great economic potential that this knowledge sector offers. The increased development and manufacturing in the sector will lead to greater economic growth through more manufacturing and consequently greater employment in the sector.

The policy sets out to achieve a turnover of about USD 400 Billion by 2020 involving investment of about USD 100 Billion. It also aims at ensuring employment to around 28 million in the sector by 2020.

Major objectives of the policy are:

a) To create an eco-system for a globally competitive Electronic System Design and Manufacturing (ESDM) sector in the country to achieve a turnover of about USD 400 billion by 2020 involving investment of about USD 100 billion and providing employment to around 28 million people at various levels.

b) To build on the emerging chip design and embedded software industry to achieve global leadership in Very Large Scale Integration (VLSI), chip design and other frontier technical areas and to achieve a turnover of USD 55 billion by 2020.

c) To build a strong supply chain of raw materials, parts and electronic components to raise the indigenous availability of these inputs from the present 20-25 per cent to over 60 per cent by 2020.

d) To increase the export in ESDM sector from USD 5.5 billion to USD 80 billion by 2020.

e) To significantly enhance availability of skilled manpower in the ESDM sector. Special focus for augmenting postgraduate

education and to produce about 2500 PhDs annually by 2020.

f) To create an institutional mechanism for developing and mandating standards and certification for electronic products and services to strengthen quality assessment infrastructure nationwide.

g) To develop an appropriate security ecosystem in ESDM.

h) To create long-term partnerships between ESDM and strategic and core infrastructure sectors-Defence, Atomic Energy, Space, Railways, Power, Telecommunications, etc.

i) To become a global leader in creating Intellectual Property (IP) in the ESDM sector by increasing fund flow for R&D, seed capital and venture capital for start-ups in the ESDM and nanoelectronics sectors.

j) To develop core competencies in strategic and core infrastructure sectors like telecommunications, automotive, avionics, industrial, medical, solar, Information and Broadcasting, Railways, etc. through use of ESDM in these sectors.

k) To use technology to develop electronic products catering to domestic needs, including rural needs and conditions, as well as international needs at affordable price points.

l) To expedite adoption of best practices in e-waste management.

Further to boost the electronics industry government has launched Electronics Manufacturing Clusters Scheme

As part of the vision to make India a leading destination for the Electronics Systems Design and Manufacturing (ESDM) sector, the draft National Policy on Electronics (NPE) proposes to achieve a domestic production of about USD 400 Billion by 2020 in the ESDM sector by creating an industry friendly policy framework and ecosystem which provides a level playing field for the domestic industry. The NPE also proposes to set up two semiconductor wafer manufacturing facilities and to create and sustain a vibrant research and development and innovation eco-system in the ESDM sector.

To achieve this target the Union Cabinet has approved the proposal to offer financial support for the development of Electronics Manufacturing Clusters (EMCs), as these EMCs would aid the growth of the Electronics Systems Design and Manufacturing (ESDM) sector, help development of entrepreneurial ecosystem, drive innovation and catalyze the economic growth of the region by increasing employment opportunities and tax revenues.

The proposed EMCs scheme would support setting up of both Greenfield and Brownfield EMCs.

The main features of the proposed EMC Scheme are as follows:

- The assistance would be provided to a Special Purpose Vehicle (SPV) which should be a legal entity duly registered for this purpose. The SPV may be promoted by private companies, industry associations, financial institutions, R&D institutions, State or Local governments or their agencies and units within the EMC. The SPV should consider including an academic/research institution to be part of the proposed SPV for suitable academic-industry linkages.
- The financial assistance to the SPV shall be in the form of grant-in-aid only.
- For Greenfield EMCs the assistance will be restricted to 50% of the project cost subject to a ceiling of Rs. 50 crore for every 100 acres of land.
- For Brownfield EMCs the assistance will be restricted to 75% of the project cost subject to a ceiling of Rs. 50 crore.
- The scheme will be open for applications for five years from the date of notification.
- The financial assistance under the policy would be subject to approval by the Competent Authority following due process.

A well developed cluster can give a unit located in it a cost advantage of 5 to 8% because of various reasons such as increased supply chain responsiveness, consolidation of suppliers, decreased time-to-market, superior access to

talent and lower logistics costs. The cluster development approach also helps in the development of entrepreneurial ecosystems which drive innovation and catalyze the economic growth of a region by increasing employment opportunities and tax revenues.

The proposed scheme is expected to help flow of investment for the development of world-class infrastructure specifically targeted towards attracting investment in the ESDM sector. Nearly 28 million persons are expected to be employed, directly or indirectly for the ESDM turnover to reach USD 400 billion. The policy covers all States and districts and provides them an opportunity to attract investments in electronics manufacturing.

COMPUTER REVOLUTION

The 21st century is witnessing a computer revolution in which information processing and retrieval are being done reliably at incredible speeds. Microprocessors which made their impact felt about fifteen years ago are the basis for a new breed of computers whose ultimate goal is to stimulate the intelligence of man. Microcomputers are becoming faster and cheaper and very soon they are expected to be as powerful as the mainframe computers. Today microprocessors can be found in pocket calculators, industrial robots, home appliances, etc.

The first four generations of computers were based on the technology of the age to which they belonged. They were thus based on the vacuum tube technology, the transistor and printed circuit technology, the integrated circuit technology, the transistor and printed circuit technology, the integrated circuit technology and the Very Large Scale Integrated (VLSI) technology respectively. The marvel of the fourth generation VLSI technology is that a microprocessor weighing a few grams, can store 512 K or 512 X 1024 bits of 0s and 1s.

Computers are analogue or digital machines. Those converting numbers into physical quantities, which can very continuously within a range are called analogue computers while those using numbers (which are discrete values) are called digital computers. There is a third class of computers called hybrid computers, which have digital storage and switching, but in them calculations are done in an analogue fashion. While analogue computers are for specific scientific/technological operations, such as harmonic analysis, solution of simultaneous algebraic and polynominal equations etc. in the fields such as hydrodynamics, aerodynamics, industrial control, etc., the digital computers are universal in that they have applications not only in the scientific field but also in the fields of business and administration. Further due to their superior flexibility and accuracy, the digital computers dominate the contemporary computer scene the latest of which are called microcomputers.

Programming Language: Computerware can be divided into hardware and software. The five functional units of a computer built with electronic circuits and electromechanical devices constitute the hardware. The range of standard programs or routines supplied by the manufacturer along with the computer hardware are referred to as software.

Computer programming is the name given to the 'art ' of writing a programme in a programming language, which is a higher level language. Every machine depending upon its internal hardware architecture has a unique low level language called the machine language. In a binary coded digital computer the machine language is made of 0s and 1s. To relieve the programmer from the tedium of writing a programme in the difficult low-level machine language, several hundreds of easier high level programming language, have been developed. Of these FORTRAN (Formula translation), and BASIC (Beginners All purpose Symbolic Instruction Code) were the most widely accepted general purpose programming languages while COBOL (Common Business Oriented Language) was the most successful programming language for business purposes.

BASIC was an on-line conversational language. It had been quickly adopted by commercial time sharing services. With the advent of microprocessors in the mid-70s, BASIC was made available as a "Read Only Memory (ROM) Chip". BASIC had many dialects and several of these included features not in the ANSI (American National Standard Institute), which standardized a subset of BASIC to promote uniformity. cBASIC and BASICA are two of the versions of BASIC.

Present day Micros: The micro-computer industry was revolutionized by the entry of IBM, which started marketing PCs in 1980.

Essentially a micro computer consists of a system unit. The printer is an auxiliary unit "essential to get the output from the micro-computer as a hard-copy. The standard type writer keys viz. A to Z, 0 to 9 and certain special characters which together constitute the alpha-numeric characters are an essential part of all the micro computer keyboards, which also have two or three additional groups of keys. One of these is a set of numeric keys (0 to 9) arranged as in a calculator for ease of data entry.

The VDU (Visual Display Unit) is the video display terminal for the micro computer system. This can be either a monochromatic (black and white) or colour monitor. The normal printer interface is for the monochromatic display unit.

A Colour/Graphics monitor Adopter board (or oriented circuit) is essential as an interface to enable the use of a colour monitor. A colour TV set can also be used with a radio frequency modulator.

The system unit contains the heart of the micro-computer-a micro processor the dynamic Random Access Memory (RAM), an extended microsoft BASIC as Read Only Memory (ROM), floppy disk drive for auxiliary storage, a built in speaker and some expansion slots for system enlargement. Additional dynamic memory (RAM) board can be used to enhance the memory of the micro computer. The ROM stores permanently, programmes essential for the operation of the micro-computers.

Modular: The micro-computer is modular in design and the modules (or blocks) are interconnected through a bus. The micro-processor or (Silicon) chip combines the ALU and the control unit, the memory (ROM and RAM), the micro -processor, a interfaces for the keyboard, VDU etc, expansion slots, speaker and timing circuits are all on the system board of mother board of a microcomputer system.

Microsoft BASIC is a version of BASIC, which is standard with the IMN-PC. The BASIC interpreter is contained in 40 K of ROM and the IBM-PC uses three versions of BASICS called cassette BASIC, disk BASIC and Advanced BASIC the first two are used when the PC has a cassette or disk interface while Advanced BASIC has all the capabilities of the other two as well as additional features necessary for the colour/graphics mode.

SUPER COMPUTERS

A supercomputer is a computer that is at the frontline of current processing capacity, particularly speed of calculation. Super-computers were introduced in the 1960s and were designed primarily by Seymour Cray at Control Data Corporation (CDC), which led the market into the 1970s until Cray left to form his own company, Cray Research.

The computers characterized by their very long size and very high processing speed are known as supercomputer. They are used in specialized area such as defence, aircraft, design, weather research and other scientific works. The first super computer was the ILLIAC IV made by Burroughs and University of Illinois in 1965.

The term supercomputer itself is rather fluid, and today's supercomputer tends to become tomorrow's ordinary computer. CDC's early machines were simply very fast scalar processors, some ten times the speed of the fastest machines offered by other companies. In the 1970s most supercomputers were dedicated to running a vector processor, and many of the newer players developed their own such processors at a lower price to enter the market. The early and mid-1980s saw machines with a modest number of vector processors working in parallel to become the standard. Typical numbers of processors were in the range of four to sixteen. In the later 1980s and 1990s, attention turned from vector processors to massive parallel processing systems with thousands of "ordinary" CPUs, some being off the shelf units and others being custom designs. Today, parallel designs are based on "off the shelf" server-class microprocessors, such as the Power PC, Opteron, or Xeon, and most modern supercomputers are now highly-tuned computer clusters using commodity processors combined with custom interconnects.

Some other areas such as molecular biophysics, quantum chemistry and reaction dynamics require high-speed numeral computing too. A conventional computer cannot

perform a high-speed computing due largely to the physical limitation known as the Von Neumann barrier. But a super computer based on parallel processor (that breaks a task into a large number of subtasks and each subtask can be carried out independently at its own pace) architect can have a computing power as high as 1000 mega flops.

Supercomputers are used for highly calculation-intensive tasks such as problems involving quantum physics, weather forecasting, climate research, molecular modeling (computing the structures and properties of chemical compounds, biological macromolecules, polymers, and crystals), physical simulations (such as simulation of airplanes in wind tunnels, simulation of the detonation of nuclear weapons, and research into nuclear fusion).

The parallel processor based computer systems are being planned to be used in the following areas:

- Remote Sensing
- Image Processing
- Signal Processing
- Launch Vehicle Dynamics
- Computational Fluid Dynamics
- Finite Element Modelling
- Computational Physics
- Computational Chemistry
- Oil Reservoir Modelling
- Astronomy and Astrophysics
- Material Science
- Computational Mathematics
- Graphics and Visualisation
- Aerodynamic application

C-DAC

The Centre for Development of Advanced Computing (C-DAC), a scientific society under the administrative control of the Department of Electronics, Government of India, has designed a general purpose Super computer 'PARAM'. The centre has transferred the know-how for the PARAM Supercomputer to many organisations in public as well as private sector. The parallel computers developed by the C-DAC are already available commercially. C-DAC has deployed several Param supercomuters in India and abroad. It has sold Param supercomputers to the UK, Germany, Philippines and Singapore. In particular, it has deployed a Param 10000 version in Russia for about Rs 2 crore under a commercial contract. C-DAC earlier announced its plans to install supercomputers at 12 premier educational institutions such as IIS and IITs.

The Supercomputer is endowed with advanced programming environment 'PARAM'. The entire design and development of PARAM, both hardware and software, have been done indigenously. Only microprocessor, memories glue-logic chips and winchester disks were imported.

The Advanced Numerical Research and Analysis Group (ANURAG) of the DRDO has also designed and developed a high-speed user-friendly super computer known as PACE (Processor for Aerodynamics Computation and Evaluations). This system finds application in several number crunching applications including geology, remote sensing, aircraft design and weather studies.

E-Learning framework by C-DAC: Pune based Centre for Development of Advance Computing (C-DAC) is developing a web-based project envisages providing an e-learning framework based learning management system. The institution is designing the e-learning framework in such a way that any kind of course material can be made available to large number of students via net.

Bioinformatics: The last few decades have been huge advances in the biological sciences. Especially in the last years, the availability of sophisticated technology has resulted in the increasingly rapid sequencing of the genetic material of several species. This deluge of information has necessitated the creation of a means to manage the data in terms of organizing, indexing and storing it. This has led to the evolution of the science of bioinformatics.

Dasher: Dasher is a data entry interface developed to replace the standard QWERTY keyboard layout. It is nearly twice as efficient, more accurate and easier on the eyes and above

all the prototype program is designed to be particularly useful for computer users who are unable to type using a conventional keyboard.

Woz Net: Woz Net is a simple and inexpensive wireless network that uses radio signals and global positioning satellite data to keep track of a cluster of inexpensive tags within a one or two-mile radius of each base station. Woz Net includes a home-based station that has the ability to track the location of dozens or even hundreds of small wireless devices that can be attached to people, pets or property. The devices or tags will be able to generate alerts, notifying the owner by phone or e-mail message when a child arrives at school, a dog leaves the yard, or a car leaves the parking lot.

Supercomputerss of the World

The list of supercomputers was announced on June 17, 2013 during the opening session of the 2013 International Supercomputing Conference in Leipzig, Germany. Tianhe-2, a supercomputer developed by China's National University of Defense Technology, is the world's new No. 1 system with a performance of 33.86 petaflop/s on the Linpack benchmark, according to the 41st edition of the twice-yearly TOP500 list of the world's most powerful supercomputers.

Tianhe-2, or Milky Way-2, will be deployed at the National Supercomputer Center in Guangzho, China, by the end of 2013. Tianhe-2 has 16,000 nodes, each with two Intel Xeon IvyBridge processors and three Xeon Phi processors for a combined total of 3,120,000 computing cores.

Titan, a Cray XK7 system installed at the U.S. Department of Energy's (DOE) Oak Ridge National Laboratory and previously the No. 1 system, is now ranked No. 2. Titan achieved 17.59 petaflop/s on the Linpack benchmark using 261,632 of its NVIDIA K20x accelerator cores. Titan is one of the most energy efficient systems on the list, consuming a total of 8.21 MW and delivering 2,143 Mflops/W.

Sequoia, an IBM BlueGene/Q system installed at DOE's Lawrence Livermore National Laboratory, also dropped one position and is now the No. 3 system. Sequoia was first delivered in 2011 and has achieved 17.17 petaflop/s on the Linpack benchmark using 1,572,864 cores. Sequoia is also one of the most energy efficient systems on the list, consuming a total of 7.84 MW and delivering 2,031.6 Mflops/W.

Fujitsu's "K computer" installed at the RIKEN Advanced Institute for Computational Science (AICS) in Kobe, Japan, is now the No. 4 system with a performance of 10.51 Pflop/s on the Linpack benchmark using 705,024 SPARC64 processing cores. A second BlueGene/Q system, Mira, installed at Argonne National Laboratory is at No. 5 with 8.59 petaflop/s on the Linpack benchmark using 786,432 cores. The latest number cruncher is capable of operating at so called "Petaflop" speeds - the equivalent of 1,000 trillion calculations per second.The ultra powerful machines will be used for complex simulations to study everything from particle physics to nanotechnology.

Blue Gene Project: Blue Gene is an IBM Research project dedicated to exploring the frontiers in supercomputing: in computer architecture, in the software required to program and control massively parallel systems, and in the use of computation to advance our understanding of important biological processes such as protein folding. IBM and its collaborators are currently exploring a growing list of applications, including hydrodynamics, quantum chemistry, molecular dynamics, climate modeling and financial modeling.

Param Yuva II

Param Yuva II was developed by the Centre for Development of Advanced Computing (C-DAC) and inaugurated on February 8, 2013. Param Yuva II is the first supercomputer that has crossed 500 teraflops in computing power in the country. Param Yuva II is the fastest supercomputer in India and 62nd fastest in the world. The supercomputer also promises to be energy efficient with 35 per cent reduction in energy consumption as compared to the earlier facility.

The supercomputer is expected to be of great help to the scientific community. Industries like pharmaceuticals, bio informatics, aeronautical engineering will also benefit. Seismic data processing can be done much more efficiently with this new computer. The main users of the supercomputer would be the scientific institutes, research laboratories and universities.

The supercomputer would also help in reducing the time-frame in weather predictions. If researchers currently collect satellite data to predict the conditions for a six-km region, the supercomputer could help cover a wider region, may be up to 10 km.

World's TOP 10 Supercomputers for June 2013

1. Tianhe-2 (MilkyWay-2)
2. Titan
3. Sequoia
4. K computer
5. Mira
6. Stampede
7. JUQUEEN
8. Vulcan
9. SuperMUC
10. Tianhe-1A

EKA Supercomputer

EKA is a supercomputer built by the Computational Research Laboratories with technical assistance and hardware provided by Hewlett-Packard. When it was installed in November 2007, it was the 4th fastest in the world, and fastest in Asia.

EKA has 1,794 computing nodes and has a theoretical peak performance of 172.2 Teraflops (tflops or trillion floating point operations per second) and a sustained performance of 132.8 teraflops based on the LINPACK benchmarks which are used by the worldwide community to rank supercomputers based on performance. Presently, it is ranked at 291.

Infrared Supercomputer

The University of Utah is implementing a computer that makes use of terahertz radiation instead of electricity. It will be the first computer powered by infrared rays rather than electricity, a super-computer capable of operating at terahertz radiation (far-infrared), the only still unexplored frontier in the electromagnetic spectrum. It is being developed by a group of scientists at the University of Utah. It will probably require ten years of work to be completed. Currently, the groups of scientists are making waveguides, the appropriate "channels" that will convey radiation and transmit it from one point to another.

To mark a decisive step forward in research, the good results obtained by the use of special sheets of perforated stainless steel which is proving able to lead effectively terahertz radiation (the portion of the electromagnetic spectrum that is between microwaves and infrared, and whose wavelength is between 1 mm and 100 micrometers). As described in the study of Ajay Nahata, these sheets will be "the matrix" on which to build the future of computer circuits.

The possible use of these radiations so far has escaped both electronics and optics. According to the researchers these will allow the development of fast and extraordinarily devices, with efficient performance from sensors used in anti-terrorism controls to next generation computers and data transfer via the Internet.

Manual mask-making facilities exist in many organisations of the country. The current capability in the country in mask fabrication is based on pattern generator and photoreceptor which have been in regular use at Bharat Electronics Limited (BEL), Bangalore for several years now and lately at CEERI, Pilani. Both the organisations have CAD facilities as well, which generate the mask drawings on magtapes. These serve as the input to the pattern generator which generates the pattern on a high resolution glass plate for making working masks.

About a dozen organisations in the country have facilities for fabricating Hybrid Micro Circuits (HMCs) primarily for in-house use. BEL and ITI have been regularly producing HMCs for the last few years. While BEL has produced hybrids for several application areas eg. Audio frequency amplifiers, radio frequency amplifiers; ITI has mostly concentrated on communication circuits . Another public sector, Electronics Corporation of India Ltd., Hyderabad has a modest facility for simple circuits.

Earth Simulator

The Earth Simulator was developed at the Earth Simulator Center in Yokohama, Japan. The Earth Simulator was a highly parallel vector supercomputer for running global climate models to evaluate the effects of global warming and problems in solid earth geophysics. The system was developed for Japan Aerospace

Exploration Agency, Japan Atomic Energy Research Institute, and Japan Marine Science and Technology Centre (JAMSTEC) in 1997. Construction started in October 1999, and the site officially opened on March 11, 2002. The project cost 60 billion yen.

The Earth Simulator supercomputer took the No. 1 spot in June 2002 with a performance of 35.86 Tflop/s (trillions of calculations per second) running the Linpack benchmark – almost five times higher than the performance of the IBM ASCI White system that had stood at the top of the previous three lists. Earth Simulator was the fastest supercomputer in the world from 2002 to 2004. Its capacity was surpassed by IBM's Blue Gene/L prototype on September 29, 2004.

For now, the Earth Simulator is being used to track global sea temperatures, rainfall and crustal movement to predict natural disasters. The computer can already predict the path of a typhoon or a volcanic corruption with remarkable precision. It was able to run holistic simulations of global climate in both the atmosphere and the oceans down to a resolution of 10 km.

QUANTUM COMPUTERS

What is quantum computing?

Quantum computing is essentially harnessesing and exploiting the amazing laws of quantum mechanics to process information. A traditional computer uses long strings of 'bits,' which encode either a zero or a one. A quantum computer, on the other hand, uses quantum bits, or qubits. Well a qubit is a quantum system that encodes the zero and the one into two distinguishable quantum states. But, because qubits behave quantumly, we can capitalize on the phenomena of 'superposition' and 'entanglement.'

Researchers have for the first time succeeded in building the first working computers based on the principles of quantum mechanics. The discovery has touched off a wave of excitement among physicists and computer scientists and is leading dozens of research centres worldwide to embark on similar experiments heralding the advent of an era of so-called quantum computers-specialised machines that may one day prove thousands or even millions of times faster than today's most powerful super-computers.

In fact, the practical demonstration of a computer based on the laws of quantum physics has created quite a flutter in the computing world. Playing with the complexities of nuclear physics and juggling sub-atomic particles, researches at IBM recently proved that a quantum computer can actually work, and may outperform the conventional computers by a large margin. According to the scientists at IBM's Research Centre in San Jose, it took just a single step to solve a mathematical problem that would take a conventional computer up to four distinct steps to handle. This experiment was described as the first experiment to confirm theoretical predictions made earlier that building a working machine based on quantum computing principles was possible.

In future, this research will help surpass contemporary silicon-based computer and chip architecture, taking advantage of some of the findings of 20th century physics, particularly, the notion that the same sub-atomic particle can exist in two seemingly opposite quantum states. As a matter of fact, the quantum computer used by the IBM team works precisely on the principle of dual states-a phenomenon not possible with conventional silicon chips.

The IBM experiment offers a glimpse of what could become a critical computing technology of the future, particularly, suited to handling elaborate security codes and solving certain types of mathematical problems that tend to baffle conventional computers. A quantum computer could help computer engineers simulate the behaviour of conventional computers based on such tiny transistors. Unlike today's conventional computers, which are assembled from arrays of millions of digital switches that can be rapidly switched on and off, quantum computers are assembled from molecularized units known as qubits.

Although there are still major hurdles to be overcome before quantum computers can be applied to general problems, yet undoubtedly, its emergence could have a profound impact on modern cryptography. Despite its promise and recent progress, the scientists acknowledged that there is much work left to do to create commercially or scientifically useful quantum computers.

Photonic Quantum Computers: A brighter future than ever

Quantum computers work by manipulating quantum objects as, for example, individual photons, electrons or atoms and by harnessing the unique quantum features. Not only do quantum computers promise a dramatic increase in speed over classical computers in a variety of computational tasks; they are designed to complete tasks that even a supercomputer would not be able to handle. Although, in recent years, there has been a rapid development in quantum technology the realization of a full-sized quantum computer is still very challenging. While it is still an exciting open question which architecture and quantum objects will finally lead to the outperformance of conventional supercomputers, current experiments show that some quantum objects are better suited than others for particular computational tasks.

Computational power of photons: The huge advantage of photons -- a particular type of bosons -- lies in their high mobility. The research team from the University of Vienna in collaboration with scientist from the University of Jena (Germany) has recently realized a so-called boson sampling computer that utilizes precisely this feature of photons. They inserted photons into a complex optical network where they could propagate along many different paths. According to the laws of quantum Physics, the photons seem to take all possible paths at the same time. This is known as superposition.

DNA COMPUTER

A group of scientists have developed a computing device using a trillion living cells. This device is so small that it can fit in a drop of water. DNA computing, also known as molecular computing, is a new approach to massively parallel computation. This microscopic computer uses enzymes as hardware, which in turn manipulates DNA molecules as software. This Computer, creating a Single mathematical computing machine, is called a finite automation.

A DNA computer is basically a collection of specially selected DNA strands whose combinations will result in the solution to some problem. Technology is currently available both to select the initial strands and to filter the final solution. The promise of DNA computing is massive parallelism: with a given setup and enough DNA, one can potentially solve huge problems by parallel search. This can be much faster than a conventional computer, for which massive parallelism would require large amounts of hardware, not simply more DNA.

This "biological nano-Computer" was created by a group of scientists headed by Mr. Ehud Shapiro, a Professor at the Weizmann Institute of Science, Israel. They have devised that the computer can perform 330 trillion operations per second, more than 100,000 times the speed of the fastest PC.

The living cell contains incredible molecular machines that manipulate information - encoding molecules available in the form of Codon (specific arrangement of DNA). In this way these devices are fundamentally very similar to computation.

1. DNA can be used to compute a class of problems that are difficult or impossible to solve using traditional computing methods.
2. It is an example of computation at a molecular level, potentially a size limit that may never be reached by the semiconductor industry.
3. Data density of DNA is impressive.
4. DNA has enormous power of parallel processing. In one fiftieth of a teaspoon of a solution, approximately 1014 DNA flight numbers were simultaneously concatenated in one second. Probably not even the fastest supercomputer available today could accomplish such a task so quickly.
5. Molecular computers also have the potential for extraordinary energy efficiency. In principle, one Joule is sufficiently for approximately 2×1019 ligation operations. This remarkable considering that the second law of thermodynamics dictates a theoretical maximum of 34×1019 (irreversible) operations per joule (at room-temperature). Existing supercomputers are far less efficient, executing at most 1019 operations per Joule.

Future: The potential of molecular computation is impressive. Researchers are now acknowledging that it would be better if molecular computation is aimed at information processing on molecular scale. Its applications in biotechnology and nano-technology have already started. In a DNA computer, the input tape and the output tape are the two strands of DNA attached to the surface of a chip. They have further proposed to use intelligent DNA chips that can perform logical reasoning and learning by using DNA computation. Nano-technology is another such area.

Interestingly, a molecular machine which can measure its environmental factors and process information technology can be designed, then such a computing device implanted within a living body will be able to integrate signals from several sources and compute a response in terms of an organic delivery device for a drug or a signal- a dream application of nature's own molecule in medical science.

DNA-based logic circuits

(i) DNA computation is an emerging field that enables the assembly of complex circuits based on defined DNA logic gates.

(ii) DNA-based logic gates have previously been operated through purely chemical means, controlling logic operations through DNA strands or other biomolecules. Although gates can operate through this manner, it limits temporal and spatial control of DNA-based logic operations.

(iii) A photochemically controlled DNA gate was developed through the incorporation of caged thymidine nucleotides into a DNA-based logic gate.

(iv) By using light as the logic inputs, both spatial control and temporal control were achieved.

(v) In addition, design rules for light-regulated DNA logic gates were derived. A step-response, which can be found in a controller, was demonstrated. Photochemical inputs close the gap between DNA computation and silicon-based electrical circuitry, since light waves can be directly converted into electrical output signals and vice versa.

(vi) This connection is important for the further development of an interface between DNA logic gates and electronic devices, enabling the connection of biological systems with electrical circuits.

PHASE-CHANGE MEMORY CHIPS

Phase-change memory chips, an emerging storage technology, could soon dethrone flash memory in smartphones, cameras and laptops. The technology relies on special substances called phase-change materials (PCMs). These are materials, such as salt hydrates, that are capable of storing and releasing large amounts of energy when they move from a solid to a liquid state and back again. Traditionally they have been used in cooling systems and, more recently, in solar-thermal power stations, where they store heat during the day that can be released to generate power at night. PCM memory chips rely on glass-like materials called chalcogenides, typically made of a mixture of germanium, antimony and tellurium.

PCM memory chips have several advantages over flash memory, which works by:

- Trapping electrons in an enclosure called a "floating gate", built on top of a modified form of transistor.
- The value stored in each cell is 1 or 0.
- Some prototype PCM memory devices can store and retrieve data 100 times faster than flash memory.
- It is extremely durable, capable of being written and rewritten at least 10m times.
- Accordingly, flash memory needs special controllers to keep track of which parts of the chip have become unreliable, so they can be avoided. This increases the cost and complexity of flash, and slows it down.
- PCM offers greater potential for future miniaturisation than flash.
- As flash-memory cells get smaller and devices become denser, the number of electrons held in the floating gate decreases.

OPTICAL COMPUTING

Optical or Photonic computing is intended to use photons or light particles, produced by lasers or diodes, in place of electrons. Compared to electrons, photons have a higher bandwidth. Presently, computers use the movement of electrons in-and-out of transistors to do logic. Most research projects focus on replacing current computer components with optical equivalents, resulting in an optical digital computer system processing binary data.

This approach appears to offer best short-term prospects for commercial optical computing, since optical components could be integrated into traditional computers to produce an optical or electronic hybrid. However, optoelectronic devices lose 30 per cent of their energy converting electrons into photons and back. This also slows down transmission of messages. All-optical computers eliminate the need for optical-electrical-optical (OEO) conversions.

SIMPUTER

The word 'Simputer' is an acronym for 'simple, inexpensive and multilingual people's computer'. Simputer is a low cost hand held computing device which can offer inexpensive and efficient information and networking environment for people who are on the wrong side of the digital divide. The simple computer or simputer runs on three AAA batteries or direct power supply. With memory capabilities of 32 MB RAM and a GNU/Linux operating system, it is more powerful than a palmtop. Further, it can be connected to internet and peripherals like keyboard or mouse can also be added. Besides, Simputer has text to speech capabilities in several Indian languages, text and editing functions, portable literacy instructor, voice messages, use of smart card facility for commercial transactions, etc. The Simputer can be put to a range of uses like micro banking through cooperatives and post offices, railway ticketing, data collection, sales automation, in education and literacy programmes. Simputers are generally used in environments where computing devices such as PCs cannot be used.

INTERNET

Internet is an inter-networked system of computers that allows free flow of information from one part of the network to any other, provided the information is packaged according to certain conventions. The Internet, however, was intimidating arena till now. Its gates were open only to those who had mastered computer commands. But, with the introduction of World Wide Web (WWW) in 1989, there is no need to master the computer command. On this web, anyone can create a home page, which millions of users can watch on their computers and respond.

In fact, the web is a hyper-media information storage system linking resources around the world. Browsers allow highlighted words or icons, called hyper-links, to display text, video, graphics and sound on a local computer screen, no matter where resource is actually located.

Application: Nowadays, the importance of Internet is so profound that it penetrates every walk of human life. Marketing in 'global village' is now a reality due to Internet. Few years back, it was just a medium for exchange of academic information and was used mostly by academicians and commerce. Today, all sorts of transactions and business deals are being conducted on Net.

On-line banks are being set up to service clients through the Net. A wide range of services are now being offered through the Net deposits, loans, transfer of funds etc. Net sites act as single window for virtual shop and offer gateways to the web-sites of scores of other shops.

Publishing business is thriving on the Net. Publishers are using the Net to serve a portion of the magazine to individual customers. On-line travel agencies are able to provide the latest and updated data of flight timing, hotel availability, reservations in train etc. to the homes their customers and, thereby, enabling the customers to perform all the transactions in the shape of movies, music, sports etc.

Internet in India: In India, Videsh Sanchar Nigam Limited (VSNL) provides Internet services since August 1995. These services which were offered initially from the four metros of Mumbai, New Delhi, Kolkata and Chennai, found

excellent demand and were soon expanded to cover a network of 42 nodes being operated by the Department of Telecommunications (DOT) and VSNL by 1998.

6th November 1998 was a landmark day in the history of Internet in India, when a revolutionary new policy was unveiled. The policy permits unlimited number of Internet players with no licence fees for the first five years, thus setting the stage for a completely deregulated operating environment. VSNL offers two types of services for Internet users:

(i) Shell account in which one can have only text access and cannot download graphics; and

(ii) TCP/IP account in which one can have access to graphics as well. It is more efficient and, therefore, more expensive.

The Indian Internet scene is headed for a radical change in the years ahead, with the National Association of Software and Services Companies (NASSCOM) predicting a massive increase in the number of Internet users.

With the arena now clear for a deregulated and open playing ground for ISPs, the stage is set for the rapid growth of Internet in India. However, the growth will be critically dependent on how some of the factors such as requirement of access lines and national backbone connectivity are addressed.

In 2013, India ranked third in the number of active users next only to China and US, the overall Internet penetration in the country is 11 per cent. India on last count had 120 million active Internet users, up from 81 million users in 2010. According to 2013 global 'Internet World Stats' report, around 2.7 billion people are using the Internet world wide which corresponds to 39 per cent of the world's population.

Real Time Service Management: Real Time Service Management is software developed by California based company SupportSoft in December 2003. It enables computer makers to provide automated support and remote correction of faults to millions of users of Personal Computers (PCs), laptops and pocket computers. The core of the RTSM is a solution, called "Resolution Suite', which when embedded in user devices, will help them to proactively heal themselves, without having to make calls to service centres or install additional chunks of software.

FPX: Filed-programmable Port Extender (FPX) is a hardware platform that can stop malicious software (malware) such as viruses and worms long before it reaches computers. John Lockwood, a computer scientist at Washington University, has developed it. The FPX can scan each and every byte of every data packet transmitted through a network at a rate of 2.4 billion bits per second. The FPX uses the Field Programmable Gate Array (FPGA) Circuits to scan computer viruses and worms quickly.

In much the same way that a human virus spreads between people that come in contact, computer viruses and Internet worms spread when computers come in contact over the Internet. Viruses spread when a computer user downloads unsafe software, opens a malicious attachment, or exchanges infected computer programmes over a network. Existing technologies do little to stop the virus or worm spread.

Internet for the Blind

Centre for Development of Advanced Computing (C-DAC) and companies like Kolkata-based Webel Mediatronics have developed computer software and hardware that would enable the visually handicapped to access Internet. Microsoft has opened two cyber cafes in Mumbai and Delhi that provide specially designed software and hardware to allow the blind to use Internet. The Delhi cyber cafe is equipped with state-of-the-art technology, including a JAWS software that allows the visually impaired to surf the net by voice enabling both input and output commands. The various tools developed by the C-DAC and Kolkata-based Webel Mediatronics are:

Vachanter: This Text-to-speech software developed by C-DAC enables the user to browse through websites through listening.

Text to Braille: It can convert text in any format to Braille and store it on the computer.

Tactile Device: It is an alternative to paper prints of Braille material.

Braille to Text: It is a software that enables blind people to enter data in braille using a 6 key keyboard.

Braille Printer: It is a PC-based embosser.

Ipv6

Indian Internet service providers and Government agencies have decided to adopt a new Net protocol which will enable creation of trillions of new Internet addresses. The new net protocol is known as Internet Protocol version 6 (IPv6), it will offer improved address space, quality of service and data security capabilities.

All Government Web sites would migrate to the new Internet protocol being adopted globally by 2013. The Department of Telecom stated that 27 websites have already been brought on IPv6 platform in India. Globally, several companies, including Google and Facebook have switched to the new IP version. Indian telecom companies will also move to the new system over the next few months.

The new version of internet protocol is necessary to prevent the Internet running out of available addresses for new devices. India at present has 35 million IPv4 addresses against a user base of about 360 million data users and Government has a target of 160 million and 600 million broadband customers by 2017 and 2020, respectively.

The existing technology IPv4 is already getting choked and expected to run out of space soon as consumers increasingly use broadband and Net services on mobile devices. The IPv6 has an in-built security protocol called IPSec, which authenticates and secures all IP data. The data carrying capacity of IPv6 networks is also going to be higher.

IT IN INDIA

Over the years, Indian IT service offerings have evolved from application development and maintenance, to emerge as full service players providing testing services, infrastructure services, consulting and system integration. The coming of a new decade heralds a strategic shift for IT services organisations, from a 'one factory, one customer' model to a 'one factory, all customers' model. Central to this strategy is the growing customer acceptance of Cloud-based solutions which offer best in class services at reduced capital expenditure levels.

The ITES sector has emerged as a key driver of growth for the Indian IT industry. This segment is poised to grow very rapidly, world-wide, over the next few years. The IT–ITES industry has two major components: IT Services and Business Process Outsourcing (BPO). The growth in the service sector in India has been led by the IT–ITES sector, contributing substantially to increase in GDP, employment, and exports.

The Indian software and services industry has emerged as one of the fastest growing sectors in the Indian economy. IT services exports is the fastest growing segment, growing by 19 per cent in FY2012, to account for exports of USD 40 billion. IT services is the fastest growing segment in the Indian domestic market, growing by 18 per cent to reach Rs 589 billion, driven by increasing focus by service providers.

According to NASSCOM, the IT–BPO sector has increased its contribution to India's GDP from 1.2 per cent in FY1998 to 7.5 per cent in FY2012. The IT–BPO sector in India aggregated revenues of US$100 billion in FY2012, where export and domestic revenue stood at US$69.1 billion and US$31.7 billion respectively, growing by over 9 per cent. Aggregate IT software and services revenue (excluding hardware) is estimated at USD 88 billion.

Software Technology Parks of India (STPI): STPI centres act as "single-window" in providing services to the software exporters and incubation infrastructure to Small and Medium Enterprises (SMEs). The STP Scheme has been extremely successful in fostering the growth of the software industry. The exports made by STP Units have grown manifolds over the years.

STPI has established new centres including High speed Data Communication facilities at Puducherry, Nasik, Thirunelveli, Allahabad and Kolhapur. STPI is also executing Cyber City Project of Government of Mauritius. The STPI Scheme is lauded as one of the most effective schemes for the promotion of exports of IT and ITES. The 51 STPI centres that have been set up since inception of the programme have given a major boost to IT and ITES exports.

National Informatics Centre (NIC): NIC provides informatics services for decision support to government offices / bodies at national, state, district and block levels. It offers network services

over Ku-band Wireless Metropolitan Area Network (MANs) and Local Area Networks (LANs), with NICNET gateway for Internet resources, facilitating informatics services for decentralised planning, improvement in government services, and wider transparency of national and local governments

CYBER SECURITY IN INDIA

The impact of information communication technology is being realised day by day in India. There has been visible introduction of ICT across the country of one billion plus population. One of the hallmarks of the fledging ministry was get Parliament to enact the Information Technology Act (IT Act) 2000. This Act gave the legal sanctity to electronic commerce in the country and also provided for some basic laws and regulations to address the usage of the internet medium.

National e-Governance Plan (NEGP): Today the number of internet users in country is growing rapidly and it would grow much further as connectivity charges reduce and multilingual applications become more prevalent and user friendly. The present efforts to implement the robust National e-Governance Plan (NEGP) by the central government will also see a major user base for internet based application in the country.

(i) There are quite a few advantages for a major thrust towards on online regime that includes e-governance and e-commerce initiatives.

(ii) There would be major impact on bringing efficiency into the system and also reducing public corruption.

(iii) The potential of internet to reach the masses as a medium for information dissemination in far-flung areas is long very strong.

(iv) Internet reduces a lot of the transaction time and costs, as is witness in the real world and that way it adds to national productivity and wealth.

(v) More and more critical systems are depending on Internet and this helps in realising many basic requirements of life.

(vi) There is a major social dimension to the spread of the Internet. There is more social interaction among global communication in more avenues of participation.

National Cyber Security Policy 2013

On July 2, 2013, the Union Government released its ambitious National Cyber Security Policy 2013. The development of the policy was prompted by a variety of factors, including the growth of India's information technology industry, an increasing number of cyber attacks and the country's "ambitious plans for rapid social transformation." The policy sets forth 14 diverse objectives that range from enhancing the protection of India's critical infrastructure, to assisting the investigation and prosecution of cyber crime, to developing 500,000 skilled cybersecurity professionals over the next five years.

To accomplish these objectives, the policy details numerous action items for the Indian government, including:

(i) Designating a national agency to coordinate all cybersecurity matters;

(ii) Encouraging all private and public organizations to designate a Chief Information Security Officer responsible for cybersecurity;

(iii) Developing a dynamic legal framework to address cybersecurity challenges in the areas of cloud computing, mobile computing and social media;

(iv) Operating a National Critical Information Infrastructure Protection Center;

(v) Promoting research and development in cybersecurity;

(vi) Enhancing global cooperation in combatting cybersecurity threats;

(vii) Fostering education and training programs in cybersecurity; and

(viii) Establishing public and private partnerships to determine best practices in cyber-security.

National Information Board

The National Information Board is the highest policy making body for cyber security and is was set up in the year 2002 and is chaired by the National Security Adviser. The NIB acts

as the highest policy formulation body at the level and periodically reports to the cabinet committee on security of the Government of India, headed by the Prime Minister. The NIB consists of 21 members most of them are secretaries of the government of India of various ministries. Two organizations support the NIB directly. The National Technology Research Organisation (NTRO) to provide technical cyber security and intelligence and the National Security Council Secretariat (NSCS) for coordinating cyber-security activities across the country, covering both the public and private sectors.

Directly below the NIB are the Information Infrastructure Protection Centre, followed by state cyber police stations and the Computer Followed by state sectoral-level CERTS. Many of the states are actively considering setting up cyber police stations and cyber labs.

The NIB has entrusted the National Security Council Secretariat (NSCS) with the role of working on cyberspace security. Again the (NISCC) within its organisation is there to provide necessary inputs to NIB for its functioning.

The role of the DIT under NOCIT is also significant. It acts as the public interface of the government with the general public and the international community as far as IT Policies in India is concerned. The DIT's role in the internet governance efforts of the UN is also laudatory, as it has also stressed the need for securing the cyberspace. Some of the relevant initiatives and strategies of DIT over the years have been:

- Promotion of the internet and provision of IT infrastructure.
- Development of the IT Act legislation and the proposed amendments.
- Promotion of standardization testing and quality in IT.
- Establishment of an Information Security Technology Development Council (ISTDC).
- Creation of a National Information Security Assurance Framework.
- Establishment of an Inter Ministerial working group.

Computer Emergency Response Team

The Indian Computer Emergency Response Team (CERT-In) is a government-mandated information technology (IT) security organization. The purpose of CERT-In is to respond to computer security incidents, report on vulnerabilities and promote effective IT security practices throughout the country. CERT-In was created by the Indian Department of Information Technology in 2004 and operates under the auspices of that department.

According to the provisions of the Information Technology Amendment Act 2008, CERT-In is responsible for overseeing administration of the Act. Basically CERT is a normative term and it is based everywhere. For India it is called as CERT-In. CERT organizations throughout the world are independent entities, although there may be coordinated activites among groups. The first CERT group was formed in the United States at Carnegie Mellon University.

Computer Immunology

On a microscopic scale, biology resembles computing: bases and genes correspond to bits and bytes, based on certain rules. Conversely, on a macroscopic scale, computing resembles biology: the internet is like a vast ecosystem where all kinds of digital organisms thrive.

The application of computing in biology, in the genome era, is well known. There is, however, traffic in the other direction as well. A US digital security company, Sana Security of San Mateo, California, has devised a way to use immunological principles to spot computer security breaches. Sana's idea is based on the ability to mimic the natural immune systems to differentiate "self" from "non-self".

Once installed, the Sana system monitors the behaviour of specific programs running on a computer, such as remote - login, web, mail and database servers. Most attacks take advantage of the flaw in these programs to gain unautho-rized access to a computer over the course of a day a so, the Sana's Primary Response builds up a profile of "normal" activity by looking at the patterns of system cells, just as an immune system builds up a profile of "self".

Any significant deviation from this profile is

then regarded as an attack. When an attack is detected, Primary Response can block all file access associated with the program under attack and prevent new programs from being launched. In addition, it also gathers forensic data, such as file-access details to work out what happened.

This approach has many advantages. Intrusion - detection system, the popular alternative to primary response, have a reputation of crying wolf. They generate, for instance, thousands of alerts every month. In that event, it is indeed difficult to distinguish a genuine attack from a false alarm. In contrast, Primary Response tends to generate only a handful of false alarms a month. The other advantage is that Primary Response is not "knowledge based". That is, it does not rely on assumptions about the nature of an attack. It works by distinguishing normal "self" from abnormal "non-self" behaviour.

DEVELOPMENT OF ELECTRONICS & COMPUTER NETWORK IN INDIA

Electronics System: The manufacture of radio receivers in the early 1950s heralded the beginning of electronics industry in India. Since then considerable progress has been made and the industry's range now extends from manufacture of consumer and professional grade electronic components to the design and development of sophisticated equipment for aerospace and defence applications.

The country is now gearing itself to meet the challenge of the electronics revolution during the rest of the decade. From a predominantly consumer oriented industry electronics had diversified to include advanced systems governing computers, controls and instrumentation besides telecommunication using advanced technology in integrated circuits.

The country entered the Large Scale Integrated (LSI) circuits/ Very Large Scale Integrated (VLSI) circuits' era in March 1984 with the trial production of the pulse dialer chip by the public sector Semiconductor Complex Limited (SCL). With an outlay of Rs 500 million the plant has contemporary facilities to fabricate the latest types of silicon chips.

In the longer perspective the task force on LSI/VLSI had formulated as a goal the need to achieve one-micron capability of research and development to enable the fabrication of one million components of a chip by 1990. The major elements of this programme include the setting up of a centre of excellence to provide a major thrust in research on process technology establishing a number of decentralized design centres both to implement the silicon foundry concept and to develop Computer Aided Design (CAD) facilities for VLSI.

The state-owned, Bharat Electronics Limited (BEL), which produced the integrated circuits in 1971, has manufactured over 50 types of bipolar ICS so far. These include 20 types of TTL version and the remaining the linear type for application in TV, AM/FM radio, multiplexing applications and voltage regulators, besides, it has fabricated a prototype watch chip with LSI capability while BEL has a vertical integrated facility covering design mask making wafer fabrication assembly and testing up to the level of MSI. SCL is building up a comprehensive production level and R & D base up to the level LSIs/VLSIs.

Besides there are several other organisations in the industrial and R & D sectors having strengths of various degrees in some or all segments of the technology. These include Central Electronics Engineering Research Institute at Pilani, Tata Institute of Fundamental research, Bombay and Indian Telephone Industries, Bangalore. In the academic sector, Indian Institute of Technology at Bombay, Delhi, Kanpur, Kharagpur and Madras have got fairly extensive facilities.

Computer Systems: As regards computer systems, the state owned Electronics Corporation of India Limited (ECIL) has made a significant contribution in manufacturing computer systems for example, 332 bit computer system. 332 has been developed and manufactured indigenously. ECIL has also demonstrated the system for its remote graphic capability. The company has "developed special purpose hardware and software for a number of applications such as telephone directory enquiry, airlines flight data recording, criminal report generation of police and message switching.

Recognizing the important role of telemetric and allied technologies which provide means for communication with the masses the Government

has set up a "Centre for Development of Telematics" (C-DOT) to develop digital electronic switching systems.

NICNET: As a forerunner the Electronics Department has taken up a project on teletext in cooperation with the Ministry of information and Broadcasting. Through this network certain information of public relevance are to be transmitted along with Doordarshan transmission. The software required for data creation updating and maintenance is being developed by the National Information Centre (NIC) of the Department of Electronics on an indigenous Computer. NIC provides computer based management information system services and related support facilities to various ministries, departments and other offices of the government. It has developed a star-type computer network (NICNET) which links up 16 micro-computers and 20 interactive terminals located in different offices in Delhi. The CDC Cyber 170/730 system procured with assistance from UNDP serves as the central node of this network. The NIC Computer system is now operational round the clock.

For the first time in the country the NIC has developed computerized information based on bibliographic data available from the International Patent Documentation Centre (INPADOC), Vienna. The system creates information and multiplied index directory files which facilitate faster and efficient retrieval of patent documents according to the International Patent classification code, date and year of publication and title of the document. These bibliographic information can be obtained interactively or in a batch mode.

In a step towards data processing NIC is setting up the INDONET, which is an integrated information management and distribution data processing facility spanning the entire country. Under the project a computer network is being set up in Mumbai, Delhi, Kolkata, Chennai and Hyderabad. It will provide local computing facilities to small and medium sectors, highly specialised software in areas of engineering designs, structural analysis, and management sciences. The professional organisation may share this sophisticated diversified system for developing software for export.

LATEST WORLD'S TRENDS

While Artificial Intelligence enthusiasts are grappling with the problems of making computers more intelligent and creative, what has been happening to computer technology in general? In the recent past, major thrust has been in making computers smaller, cheaper and more robust. Advances in microelectronics technology have made it possible to achieve all these three objectives at the same time.

It is quite clear that even the most user friendly computer is at present so difficult to use for most people. Our normal mode of interacting with people involves a lot of hand waving. We leave many things unsaid, taking advantage of shared context and shared presuppositions. Life would become impossible if instructing another person requires specifying everything to the minute detail, explicitly taking into account all possible contingencies but this is precisely what computers demand and what computer programming is all about.

Indian Scene

How has computer technology transformed the Indian scene in the last few years? After a confused, hesitant and uncertain start the transformation has certainly speeded up and become visible in the last decade. At one level, there is the official view of what has been achieved. At the level of ordinary person at least a handful of computer applications have made a visible and high impact. By far the most important of these in undoubtedly the computerization of railway reservation for the more effluent, computerized air reservation and computerization of checking formalities at the airports have certainly made air-travel less of a hassle. Most hotels have computerized their operations. Sales computerization in departmental stores and supermarkets are rapidly becoming the norm. Postal services, banks, hospitals, and government transaction with the ordinary public are yet to transform themselves significantly through the use of information technology.

Information technology (that is the integrated use of computers and communication) is the basic needed to support the service sector. For the ordinary citizen

improvement of services of all kinds is an essential pre-requisite to improving the quality of life but it is a pity that purposeful beginning made in the early 80's to use information technology to upgrade the quality of life in India have been allowed to drift and languish for want of committed government leadership.

India pioneers in innovations aimed at making the lives of common people easier at an affordable price and Aakash is the step in that direction. Aakash world's cheapest internet device was conceived under the Human Resources and Development Ministry's National Mission on Education through Information and Communication Technology (NME-ICT) to provide students a device that could be used as an E-book reader, to access online streaming course material and web based research. Under NME-ICT, the government intends to deliver 10 million tablets to post-secondary students across India. This is a bold step in popularising computer interfaced science experiments in India.

TELECOMMUNICATION SECTOR

FIBRE OPTICS

In the field of fibre optics, India is now poised to become the first developing country to make use of fibre optics-the new technology of transmitting information with beams of light to solve many problems being faced in telecommunications industry and medicine.

It is a new technology that has enormously increased man's capacity to move words, pictures and data from place to place. Simply, telephone conversations, television broadcasts, computer data or any other message can be translated into light wave and sent through glass wires instead of the conventional technique of translating them into electrical impulses and sending them through copper wires. The information, transmitted through optical fibres, is in digital form as pulses of light. Tiny strands of very pure glass, as thin as a human hair, can carry up to 8000 simultaneous telephone calls in a core just 1/200 millimetre across.

Fibre optics is the use of very fine transparent fibres of glass with the purpose of transmitting light. Light passes along the fibres by a series of total internal reflections. In fact, it is a system for transmitting light through hair flexible rods (i.e., fibres) made of transparent glass or plastic.

Applications: One familiar use of the fibre is in ornamental displays (i.e., lighting trees), but more important is their use in examining interior organs of the body and as economical substitutes for telephone cables.

Medical instruments using fibre optics are named according to the part of the body they are designed to examine, e.g., bronchoscope (bronchial tubes), cystoscope (bladder), gastroscope (stomach), and sigmoidoscope (lower large intestine). In all of these, a bundle of fibres transmit light from an outside lamp to illuminate the part of the body being examined. Another bundle of several thousand fibres has an objective lens at one end and an eyepiece lens at the other. The objective lens forms an image of the body part. This image is transmitted, point by point, through the fibres to the eyepiece lens, which magnifies the image.

For telephone cables, glass fibres are used in place of copper wires. A pair of hair-thin glass fibres can carry several thousand conversations at one time, replacing several hundred wires within a cable-an enormous saving in space and money. The telephone message, first converted by a laser apparatus from electrical currents to pulses of light are transmitted through the glass fibre, and are then converted back to electrical form at the far end. There they are sorted out and sent on to their receiving destinations. Glass fibres are also used for high-density phone lines between major cities and for cross-channel cables. Since glass fibre is electrically a non-conductor, it is not affected by electromagnetic interference. They can be used in high explosives as well as high-voltage environment as they are immune to thunderstorms, lightning or large electrical motors.

Photonic Band Gap making a Revolution

A team of scientists in the United Kingdom developed a revolutionary super-effective optical fibre that guides the light through a central hole, which can dramatically upgrade the power-carrying capacity of optical fibres into the multi-kilowatt region. This fibre technology is the world's first multi-kilowatt single mode fibre.

Till now, a solid optical fibre can carry limited raw laser power and at very high power, the

glass simply cannot cope with the intense fields and is torn apart. However, with the development of new optical fibres having a large hole in the middle that potentially permits the transmission of huge amounts of energy, the problem has been solved. Traditionally, optical fibres carry light through a glass core covered by a cladding which prevents the light from leaking out.

In recent years, two new types of optical fibres have revolutionised this dynamic field, bringing with them a wide range of novel optical properties. These new fibres, known collectively as microstructured fibres, can be made entirely from one type of glass as they do not rely on dopants for guidance. Instead, the cladding region is peppered with many small air holes, that run the entire fibre length. These fibres are typically separated into two classes, defined by the way in which they guide light:

- Holey fibres, in which the core is solid and light is guided by a modified form of total internal reflection as the air holes lower the effective refractive index of the cladding relative to that of the solid core.
- Photonic band-gap fibres, in which guidance in a hollow core can be achieved via photonic band-gap effects.

Optical-fibres in India: In India, over 22 research institutions are engaged in various system aspects of optical fibres, communication fibres and associated material technology. The Telecommunication Research Centre in Delhi has developed terminal equipment for a 120-telephone channel system. The Centre for Development of Telematics (C-DOT) has developed a 128-line digital switching system.

The Indian Institute of Technology, New Delhi has a facility for testing fibres and engaged in perfecting already existing measurement techniques and trying to develop new methods to characterise fibres (pulse dispersion, refractive index, profile measurement, etc.)

The Defence Solid State Physics Laboratory, Delhi has succeeded in fabricating the gallium-arsenide lasers, while CSIO is developing a machine for drawing plastic-coated silica fibres.

Research and development, and measurement technique related to characterisation and evaluation of communication grade fibre are being done at the Indian Institute of Technology, Delhi, and Central Scientific Instrument Organisation (CSIO), Chandigarh. Research in the field of launching optical signals and detection of signals with imported sources is going on in several institutions of the country.

In India, the first optical fibre communication system was set up in Pune, connecting Shivaji Nagar and Cantonment Exchanges. Buried two metres underground, the glass fibre imported from Japan provided 120 telephone channels and has been functioning without any fault since 1979. The Hindustan Cables Ltd. has started manufacture of optic fibre cables at its Naini, factory in Allahabad.

National Optical Fibre Network

The Department of Telecommunications (DoT) on July 22, 2011 cleared creation of a 'National Optical Fibre Network' (NOFN) with an investment of Rs.20,000 crore that would provide broadband connectivity to all village panchayats in three years. The Telecom Commission has approved the project that will be funded through the Universal Service Obligation (USO) Fund. The project will be completed by 2014-15 through a special purpose vehicle (SPV). The funding for the broadband network will come from the USO fund, the USO fund has a balance of Rs 16,000 crore.

NFON will also help the government implement its various e-governance initiatives such as e-health, e-banking and e-education, facilitating inclusive growth. NOFN will enable effective and faster implementation of various mission mode e-governance projects amounting to Rs.50,000 crore initiated by the Department of Information Technology as well as delivery of a whole range of electronic services by the private sector to citizens in rural areas.

Once completed, the optic fibre network will help bring various electronic and Internet-based initiatives of the government to the people living in the remotest corner of the country. The broadband project will initially be executed by Bharat Sanchar Nigam Limited and other PSUs like RailTel.

Bharat Broadband Network Limited (BBNL) was established in pursuit of a high-level

policy declaration of 'broadband for all' by the central government in 2009. BBNL would implement National Optical Fibre Network (NOFN), which is expected to open up the gateway to rural development, by facilitating implementation of the e-Government projects in the social sectors like education, health, social security, employment guarantee, financial and banking services, all fostering inclusive growth for rural India. It is further expected that this would also provide a great fillip to private sector for providing other services in the remote places on a viable business model which is hitherto non-existent.

Global Market

The global optical cable market posted 10 per cent growth in 2012 with a stronger growth forecasted in 2013. China now accounts for half of global cabled-fibre deployments. The massive cable deployments in China's FTTx projects and wireless infrastructure were key drivers in the global cable market's double-digit growth last year. Other markets, Europe and North America, saw a decline in growth due to ongoing economic uncertainty and the spending cycles for publicly financed broadband network projects. Nevertheless, world optical cable demand increased to 235 million fibre-km in 2012. China's growth in 2012 was approximately 20 per cent, and the forecast is for comparable growth this year. Australia, India, Mexico, Russia, and South Africa are other key markets poised for 2013 growth. Fibre-to-the-Premises (FTTP), Fibre-to-the-Home (FTTH), and Fibre-to-the-Building (FTTB) applications are some of the key factors driving the demand for fibre optic cables industry worldwide.

GPON Technology

In a move that would give the much-needed push to broadband penetration in the country, the Centre for Development of Telematics (C-DoT) recently transferred indigenously-developed Gigabit Passive Optical Network (GPON) technology to seven telecom equipment manufacturers, including private players. The GPON technology is a pivotal component required for broadband connectivity over optical fibre.

The cost-effective GPON will prove to be a game-changer technology for India. It can be used to provide triple play (voice, video and data). The present GPON standards specify 2.5 Gbps (Gigabit per second) downstream and 1.25 Gbps upstream data capability to customer premise. Apart from urban areas, especially multi-dwelling units, the large data carrying capability is important for Indian villages too where prevailing low literacy levels will necessitate information with greater graphic and audio content for better dissemination. It will give a boost to broadband connectivity across India.

Besides, voice telephony, high speed Internet access and IPTV, the C-DOT GPON has provision to carry cable TV signal too, all on a single optical fibre. Another important advantage of GPON is that it can carry information from a central office to subscribers up to 60 km away without needing any intermediate repeaters thus doing away with the requirement of power, shelter and upkeep services at the intermediate locations.

WI-MAX TECHNOLOGY

A new wireless technology, Wimax, can cost effectively bring high speed internet services to rural areas. With backers like Intel Corporation and Fujitsu, the technology is promising. But Indian companies seem to be intent on introducing the technology in only urban markets.

Advantage: Telecommunication companies have always said that it is too expensive to lay high-speed internet cables in villages because the profits are much lesser than the expenses. Both Wimax and its processor wi-fi use radio waves to broadcast internet signals, thus removing the need to use cables. Whereas wi-fi could only broadcast signals upto a hundred metres away from the transmission towers, Wimax technology can transmit signals upto three kilometers away and it supports speeds five times faster than what its counterpart (wi-fi) does.

Wimax Forum: Reliance Infocomm Limited, Sify Limited and Tata Teleservices Limited - the leading telecom players of India are part of the Wimax Forum, a global consortium of companies involved in promoting the technology. These companies are planning to start pilot trials of Wimax in India very soon.

Utility: A few companies, such as Chennai based n-Logue Communications Private Limited, have endeavoured to bring in the information revolution to rural India. N-Logue has set up kiosks providing Internet services in several villages of Gujarat, Maharashtra and Tamil Nadu; villages have used this service to get medical consultations and establish a link with agricultural experts. More such projects are required to make the villagers realise the benefits of the Internet, thereby generating demand. Experts hope that rural India might make it to the telecommunication industry's agenda by 2005, when Wimax will be launched in the market.

WIFI

WiFi stands for the wireless fidelity, is a wireless networking technology used across the globe. WiFi became very popular because once base station is there, any number of desktops or laptop computers can be connected to broadband service without the need of any cables or installing extra phone lines. It mainly refers to using radio frequencies and/ or infrared waves.

The main purpose of Wi-Fi is to hide complexity by enabling wireless access to applications and data, media and streams.

The main advantages of the Wi-Fi are :

- Make access to information easier.
- Ensure compatibility and co-existence of device.
- Eliminate cabling and wiring.
- Eliminate switches, adapters, plugs, pins and connectors.

It allows LANs (Local Area Networks) to be deployed without cabling for client devices, typically reducing the costs of network deployment and expansion. Space where cables cannot be run, such as outdoor areas and historical buildings, can host wireless LANs.

A Wi-Fi enabled device such as a PC, game console, mobile phone, MP3 player or PDA can connect to the Internet when within range of a wireless network connected to the Internet. The coverage of one or more interconnected access points called a hotspot can comprise an area as small as a single room with wireless-opaque walls or as large as many square miles covered by overlapping access points. Wi-Fi technology has served to set up mesh networks.

In addition to restricted use in homes and offices, Wi-Fi can make access publicly available at Wi-Fi hotspots provided either free of charge or to subscribers to various providers. Organizations and businesses such as airports, hotels and restaurants often provide free hotspots to attract or assist clients. Enthusiasts or authorities who wish to provide services or even to promote business in a given area sometimes provide free Wi-Fi access.

Wi-Fi also allows connectivity in peer-to-peer (wireless ad-hoc network) mode, which enables devices to connect directly with each other. This connectivity mode can prove useful in consumer electronics and gaming applications.

Comparison with Wi-Fi

WiMAX provides services analogous to a cellphone, Wi-Fi is more analogous to a cordless phone. Wi-Fi is a shorter range system, typically hundreds of metres, generally used by an end user to access their own network. Wi-Fi is low cost and is generally used to provide Internet access within a single room or building. For example, many coffee shops, hotels, railway stations and bus stations contain Wi-Fi access points providing access to the Internet for customers.

Wireless Routers which incorporate a DSL-modem or a cable-modem and a Wi-Fi access point, often set up in homes to provide Internet-access and inter-networking to all devices connected (wirelessly or by cable) to them. One can also connect Wi-Fi devices in ad-hoc mode for client-to-client connections without a router. Wi-Fi allows LANs to be deployed without cabling for client devices, typically reducing the costs of network deployment and expansion. Wireless network adapters are also built into most modern laptops.

BI-FI

Recently, researchers from Stanford University are harnessing the key attributes of a virus 'M13' to develop the first biological Internet or 'Bi-Fi' by creating a mechanism to send genetic messages from cell to cell. The system greatly

increases the complexity and amount of data that can be communicated between cells and could lead to greater control of biological functions within cell communities. Bio-engineering researchers have parasitised the parasite and harnessed M13's key attributes — its non-lethality and its ability to package and broadcast arbitrary DNA strands — to create the biological Internet or 'Bi-Fi'.

The Stanford University revealed that Biological Internet could lead to biosynthetic factories in which huge masses of microbes collaborate to make more complicated fuels, pharmaceuticals and other useful chemicals, including the regeneration of tissue or organs in future.

The virus 'M13' is a package of genetic messages. It reproduces within its host, taking strands of DNA - strands that engineers can control - wrapping them up one by one and sending them out encapsulated within proteins produced by M13 that can infect other cells. The M13-based system is essentially a communication channel. It acts like a wireless Internet connection that enables cells to send or receive messages, but it does not care what secrets the transmitted messages contain.

BROADBAND

Broadband could be defined as an always on connection that is able to support various interactive services and has the capability of a minimum download speed of 256 kbps or kilobits per second. High-speed internet is also commonly called broadband internet. To put that in context, an average telephone line through which we dial into the internet theoretically gives a speed of 33.3 kbps, though actual speeds may be far lesser. An affordable broadband access to the Net would allow a PC to be used as a TV/ music system. One can watch a downloaded movie or listen to an older-goldie track or merely get the latest quotes for one's stock portfolio.

The major types of broadband include DSL, cable, satellite, fibre-optic and mobile broadband.

DSL: Digital Subscriber Line (DSL) is broadband internet delivered over copper phone wires. The lines are split into two frequencies: one for data and one for voice. Traditional DSL speeds range from 768 Kbps to as fast as 7 Mbps--but must be located within 2 miles of the phone company's central office for optimal speed.

Fibre: Fiber-optic broadband is a broadband internet delivered over fibre-optic lines--these use light to transmit data signals at far faster speeds than traditional copper wires or coaxial cables.

Cable: Cable broadband internet delivers data at broadband speeds over the same cable used to deliver television data. Basic cable internet speeds range from 6 Mbps to 18 Mbps, while more advanced cable internet can reach speeds of 75 Mbps and more. Cable Internet speeds can be affected by users within the same vicinity using the same cable connection.

Satellite: Satellite broadband uses orbiting satellites to transmit and receive broadband data. Satellite broadband is primarily used in areas where terrestrial broadband technologies like DSL, fibre and cable are otherwise unavailable. Speeds for satellite broadband are comparable to traditional DSL, ranging from 768 kbps to 5 Mbps--but data speeds can be affected by changes in the weather and satellite position.

Mobile Broadband: Mobile networks are a wireless broadband technology accessible via 3G/4G/LTE enabled cellphones and smart devices like ebook readers. Speed differs between carriers and can be affected by user location and carrier coverage. The fastest wireless technology, LTE, offers maximum theoretical download speeds of up to 150 Mbps.

WIRELESS LOCAL AREA NETWORKS (WLANS)

A wireless LAN is a flexible data communication system implemented as an extension to, or as an alternative for, a wired LAN within a building or campus. Using electromagnetic waves, WLANs transmit and receive data over the air, minimising the need for wired connections. Thus, WLANs combine data connectivity with user mobility, and through simplified configuration enable movable LANs.

Wireless LANs frequently augment rather than replace wired LAN networks - often providing the final few metres of connectivity between a backbone network and the mobile user. The power and flexibility of wireless LANs finds applications both in the office as well as in

home environments. It can also be used in consulting and sales, manufacturing and warehousing, corporate office, retail applications, education and research, trading and banking and also healthcare.

Benefits of wireless LANs over traditional wired network:

- Mobility
- Installation speed and simplicity
- Installation flexibility
- Reduced cost of ownership
- Scalability
- Wireless LAN - Technology
- Spread Spectrum
- Narrowband Technology
- Frequency - Hopping Spread Spectrum Technology
- Direct - Sequence Spread Spectrum Technology
- Infrared – Technology

'3G' MOBILE TECHNOLOGY

'3G' or bugs free third generation cellular technology will satisfy all 'bandwidth-hungry applications' such as full-motion video, video salient conferencing and full Internet access.

- The major advance in 3G systems is moving from speech and low rate data transmission to medium and high speed data for video (TV) transmission and Internet searching.
- The 3G mobile systems will increase the data rate by 200 times.
- They will improve audio quality, marking a total change in telephone usage from exclusively voice to predominantly data services.
- A 3G user can see the other user on his display screen.
- While transmitting video images and data, the user need simply push a button to talk with image receiver.
- Film clips can be seen clearly and instantly.
- There is hardly any jumping or slow motion display.

In Europe, the US and most parts of Asia are embracing 3G technologies but in India it is in initial stage and some telecom operators are providing the 3G services. After more than eight years of wireless usage, the country still does not have a clear-cut policy for allocating frequencies, a vital element in the introduction of any wireless technology. The World Bank recognised India's lack of progress in this regard and forked out a huge grant to modernise the frequency allocation systems. Progress is taking place but at a slow pace.

4G TECHNOLOGY

4G is the fourth-generation cellular communication system that operates on Internet technology using various wired and wireless networks. It combines applications and technologies like Wi-Fi and WiMax, so that highest throughput and lowest cost wireless network is possible, providing high quality, high security and any kind of services, anytime, anywhere to the users. In simple language, it provides MMS, multimedia and video applications in mobile or wireless format. The main features of 4G are:-

(i) The 4G technology is to provide interactive services like video conferencing, Wireless Internet, Multimedia Messaging service, Video chat, mobile TV, High definition TV content and needless to say, voice and data services, anytime and anywhere.

(ii) There will be high network capacity, high speed data transfer rate at any two points in the world, seamless connectivity and global roaming.

(iii) No new infrastructure is needed to be installed, as 4G will be interoperable with existing wireless standards, dynamically sharing and utilizing the already existing network resource.

(iv) It will have the feature of smelling the background of the other person on the phone. If someone is cooking something and he/she wants you to smell it, he/she would be able to do that.

How 4G Works?

4G wireless networks use two types of addresses for communication between two devices, for example a computer and a cell phone. Each node will be assigned a 4G-IP (Internet Protocol) address, which will be formed by a permanent home IP address and a dynamic care-of address that will represent the phone's actual location. When a computer using Internet wants to communicate with a cell phone in the wireless network, the computer will send a packet to the 4G-IP address of the cell phone. Then a directory server on the cell phone's home network will forward this packet to the cell phone's care-of address through a mobile IP. The directory server will also inform the computer of the cell phone's care-of address (the real location), so that the next packet can be sent to the cell phone directly.

Benefits of 4G

The advanced applications of 4G systems will primarily be location-based services. 4G location applications would utilize visualized, virtual navigation schemes that would support a remote database containing graphical representations of streets, buildings and other physical characteristics of a large area. Thus, the benefits will include:

Tele-geoprocessing: It is a combination of Geographical Information Systems (GIS) and Global Positioning Systems (GPS), working together in a high-capacity wireless mobile system. Using this, public safety will be enhanced by reading the environment of even a remote place and understanding the problems of the concerned area.

Virtual Navigation: The database can be accessed by a subscriber in a moving vehicle equipped with the appropriate wireless device, to know about the roads and locations in advance.

Tele-medicine: A paramedic assisting a victim of a traffic accident in a remote location would be able to access medical records (eg. x-ray sheet) and establish a video conference so that a remotely-based surgeon could provide "on-scene" assistance.

Crisis-management Applications: In case of natural disasters, where the entire communications infrastructure is in disarray, restoring communication quickly will be essential. Using 4G both limited and complete communication capabilities, including Internet and video services, would be set up in a matter of hours.

Bluetooth Technology

Bluetooth is a short range, wire free, secure and international standardized wireless technology that provides wireless communication system between the Bluetooth enabled devices in a short ranged network. Bluetooth technology is a short range wireless technology that was developed by the collaboration of mobile phones and IT companies such as Nokia, Intel, Toshiba, Ericsson and IBM. Bluetooth develops short range wireless connections between the laptops, handheld PCs, wireless communication devices and mobile phones. Bluetooth is only available to the personal area networks in an office or a home network. It reduces the usage of power as compared to the Wi-Fi. Bluetooth is an international standardized technology that is used for the wireless communication between the Bluetooth held devices such as mobile phones, digital camera, laptops, desktop computers, keyboard, mouse, MP3 players, video cameras and other devices.

Bluetooth is free technology and it is provided by the mobile phone operators who are having the capability of GSM and CDMA technology. Bluetooth uses radio-waves frequency as a medium and is suitable for the 1, 10 and 100 metres distance. Every Bluetooth enabled device such as mobile phones, laptops, digital cameras; video games consoles have built-in microchip.

Bluetooth uses radio-waves that operate at 2.4 GHz bands. The personal computers must have built-in dongle in them to use the Bluetooth technology. Bluetooth is also used to transfer the files from the mobile phones or PDA devices to the computers. Also, in a meeting if you want to share the digital business cards among the participants of the meeting you use Bluetooth to transfer the files. Microsoft Windows XP with the service pack 2 has the built-in support for the Bluetooth technology. Bluetooth defines the wireless standards to maintain the secure data communication.

The master Bluetooth device can communication with the seven other Bluetooth enabled devices. Different devices support different standards of the Bluetooth technology. The research on the advanced Bluetooth is in progress for the Bluetooth version 3.0 to provide the high speed connections.

Bluetooth technology also provides support for the VOIP technology. The Bluetooth headset provides the wireless extension to the Bluetooth device. A typical Bluetooth device consist of RS transceiver, protocol stacks and base bands and it does not require to install the additional drivers to use the Bluetooth technology and it can connect all the office peripheral such as computer with printer, computer with scanner and computer with laptop. Among the other advantages of the Bluetooth technology is the automatic synchronization of the desktops, mobile phones and other Bluetooth held devices. Another popular use of the Bluetooth is in the cars and automotives. The most commonly Bluetooth held devices are mobile phones, personal computers, laptops, headsets, access points, car kits, speaker phone, streaming video, MP3 players, SIM cards, Push-2-talk, PDA and digital camera.

By this technology, mobile data can be used in the different applications. It provides the speed of 1-2 Mbps. Bluetooth's small microchip can be built in the devices and it can also be used as the external adapters and used for the different network commu-nication devices. Bluetooth enabled devices can change their frequency very rapidly so they can be saved from the external interference. Bluetooth enabled devices have built in security features and they use pin code and 128 encryption. If the two wireless devices follow the Bluetooth standards they can communicate with each other without any external devices or wires. More enhancements are in progress in this technology to provide the most robust, state-of-the-art, high speed and secure connections to the mobile users.

Applications of Bluetooth:

- Wireless control and communication between a mobile phone and a hands-free headset.
- Wireless networking between PCs in a confined space and where little bandwidth is required.
- Wireless communication with PC input and output devices, the most common being the mouse, keyboard and printer.
- Transfer of files, contact details, calendar appointments, and reminders between devices with OBEX.
- Replacement of traditional wired serial communications in test equipment, GPS receivers, medical equipment, bar code scanners, and traffic control devices.
- For controls where infrared was traditionally used.
- For low bandwidth applications where higher [USB] bandwidth is not required and cable-free connection desired.
- Sending small advertisements from Bluetooth-enabled advertising hoardings to other, discoverable, Bluetooth devices.
- Two seventh-generation game consoles, Nintendo's Wii and Sony's PlayStation 3, use Bluetooth for their respective wireless controllers.
- Dial-up internet access on personal computers or PDAs using a data-capable mobile phone as a modem.

CDMA

Code division multiple access (CDMA) is a channel access method utilized by various radio communication technologies. It should not be confused with the mobile phone standards called CDMA 1 and CDMA2000 (which are often referred to as simply "CDMA"), which use CDMA as an underlying channel access method.

One of the basic concepts in data communication is the idea of allowing several transmitters to send information simultaneously over a single communication channel. This allows several users to share a bandwidth of different frequencies. This concept is called multiplexing. CDMA employs spread-spectrum technology and a special coding scheme (where each transmitter is assigned a code) to allow multiple users to be multiplexed over the same physical channel. By contrast, time division multiple access (TDMA) divides access by time, while frequency-division multiple access (FDMA) divides it by frequency. CDMA is a form

of "spread-spectrum" signalling, since the modulated coded signal has a much higher data bandwidth than the data being communicated.

An analogy to the problem of multiple access is a room (channel) in which people wish to communicate with each other. To avoid confusion, people could take turns speaking (time division), speak at different pitches (frequency division), or speak in different languages (code division). CDMA is analogous to the last example where people speaking the same language can understand each other, but not other people. Similarly, in radio CDMA, each group of users is given a shared code. Many codes occupy the same channel, but only users associated with a particular code can understand each other.

TELECOM SERVICES IN INDIA

In the field of communications, from essentially a telegraph network in late forties, the Indian telecommunication network facility has grown significantly over the years with the acquisition, adaptation and indigenous development of newer technologies.

The country has now developed the necessary capability to manufacture her own sophisticated materials and equipment, for example, telephone instruments, digital telephones, key telephones and microwave and line systems. The major areas in the plan of Indian Telephone Industries (ITI) relate to digital telephone subscriber apparatus and instrumentation, telemetrics and powerline carrier communication systems, and integrated communication systems.

Today, the network provides for nationwide dialing, enabling speech transmission, long distance links through satellites and fairly efficient switching systems like the electronic stored programme controlled (SPC) switching systems.

The ITI is the main national organisation providing hardware for the network. Specialised communication equipment needed for defence, power administration, railways, ONGC, and other organisations are met by ITI, BEL and ECIL.

Even remote towns can be connected to the national telephone network with the help of the most advanced digital integrated local-cum-trunk exchange developed by the ITI, Bangalore in collaboration with the TRC.

Computers in Telecom Services: Computers have been introduced to modernise business and consumer services in the large telephone system. The first phase of the project in operation involved 'directory enquiry service'. The facility is being extended to cover commercial billing fault analysis and fault control traffic accounts.

The National Centre for Software Development and Computing Techniques (NCSDCT) in Mumbai has provided the R &D and human resources base for Indian software development and exports.

Inmarsat: It stands for International Maritime Satellite founded in 1979. INMARSAT organisation has more than 80 countries as its members with London as its headquarters that provides worldwide satellite communications for maritime, aeronautical and mobile land users. INMARSAT operates a satellite each in the Indian Ocean and the Pacific Ocean region. The Vikram Land Earth Station, which was commissioned on May 31, 1992 at Arvi, about 85 km from Pune and became operational on July 11, 1992, is the 37th such station in the INMARSAT family. Besides the satellites and the land earth stations (LES), the INMARSAT system also has mobile earth stations with the satellite communications terminals located on ships, trucks, etc. The Vikram LES is providing shore-to-ship and ship-to-shore telephone, telex, fax, etc. Maritime INMARSAT terminals have a special feature that automatically generates and sends distress messages to rescue coordination centres.

COMMUNICATION AND BROADCASTING

Under the liberalised licensing regime, the whole area of telecom and broadcasting equipment was delicensed and emphasis was given to promotional activities for attracting foreign investments, exports, private telecom network, decentralization of telecom services, and technology development. These measures are expected to bring a sea change in national telecommunication scenario and make India internationally competitive. On July 16, 2013, the Union Government decided to liberalise the

foreign direct investment (FDI) regime further. In the telecom sector, FDI limit hiked under the automatic route to 49 per cent and 49 to 100 per cent under the FIPB route.

As a result of the liberalisation, a large number of proposals were received from Indian and foreign companies to manufacture switching equipment, transmission equipment, and two-way radio communication equipment. Siemens, Ericsson, and Fujitsu were selected for the manufacture of large capacity digital exchanges.

To promote faster growth of telecom services, a decision has been taken to allow State Governments for setting up Telecom Networks in the industrial estates with access to DoT lines. Accordingly, State Governments are making proposals to develop telecom infrastructure in the States.

A number of new thrust areas and gap areas were identified for development in telecom and broadcasting sector. Electronics Development and Research Centre (ERDC), Pune of the DoE undertook the indigenous development of low-cost Amateur Radio, Citizen Band Radio and Data Radio suitable for rural applications. There are about 200 companies in the country manufacturing telecom and broadcast equipments.

NATIONAL TELECOM POLICY 2012

The Government approved National Telecom Policy (NTP) 2012, which addresses the vision, strategic direction, and the various medium- and long-term issues related to the telecom sector, on 31 May 2012. NTP-2012 is aimed at maximizing public good by making affordable, reliable, and secure telecommunication and broadband services available across the country. The objectives of NTP-2012 include the following:

- Provide secure, affordable, and high-quality telecommunication services to all citizens.
- Strive to create One Nation-One Licence across services and service areas.
- Achieve One Nation-Full Mobile Number Portability and work towards One Nation-Free Roaming.
- Increase rural tele-density from the current level of around 39 to 70 by the year 2017 and 100 by the year 2020.
- Recognize telecom, including broadband connectivity, as a basic necessity like education and health and work towards 'Right to Broadband'.
- Provide affordable and reliable broadband-on-demand by the year 2015 and to achieve 175 million broadband connections by the year 2017 and 600 million by the year 2020 at minimum 2 Mbps download speed and make available higher speeds of at least 100 Mbps on demand.
- Provide high-speed and high-quality broadband access to all village panchayats through a combination of technologies by the year 2014 and progressively to all villages and habitations by 2020.
- Recognize telecom as an infrastructure sector to realize the true potential of information communication technology (ICT) for development.
- Address right-of-way (RoW) issues in setting up of telecom infrastructure.
- Mandate an ecosystem for ensuring setting up of a common platform for interconnection of various networks for providing non-exclusive and non-discriminatory access.
- Strive for enhanced and continued adoption of green policy in telecom and incentivize use of renewable resources for sustainability.
- Achieve substantial transition to the new Internet Protocol (IPv 6) in the country in a phased and time-bound manner by 2020 and encourage an ecosystem for provision of a significantly large bouquet of services on the IP platform.

IPR IN INDIA

Major changes to Indian Copyright Law were introduced in June 1994. This has made the Indian Copyright law, one of the toughest in the world. The amendments to the Copyright Act in June 1994 included the definition of Computer Program. The Copyright (Amendment) Act 1994, clearly explains the rights of copyright holder, position on rentals of software,

the rights of the user to make backup copies and the heavy punishment and fines on infringement of copyright of software. At present officers of these government agencies, NASSCOM officials, police and various other law enforcement officers of Government of India are committed to enforce copyright laws and eradicate the menace of software piracy. Raids jointly facilitated by NASSCOM and Business Software Alliance with active cooperation from law enforcing authorities over last one year at some of the major metro cities have already had salutary effect.

To protect the intellectual property rights (IPR) of software companies, apart from cracking down on piracy, the government has also made several policies to actively discourage piracy. Authorized sellers of imported software are allowed to reproduce software in India and sell it without import duty. Local software manufacturers are exempt from excise taxes.

Other incentives include:

- Depreciation on IT products allowed at 60% pa, taking into cognizance the high rate of obsolescence of such products.
- Exemption of withholding tax on interest on ECBs is proposed to be extended to the IT sector as well. This will reduce cost of borrowings for IT companies through the ECB route.
- 100% customs duty exemption on all software used in the IT sector.
- Extension of 80HHE Tax benefit to the supporting developers. This will enable supporting developers to enjoy tax concessions, similar to the supporting manufacturer's concept in manufacturing sector.

The Copyright (Amendment) Act 2012 passed by Parliament has come into effect declaring authors as owners of the copyright, which cannot be assigned to the producers as was the practice till now. It will now become mandatory for broadcasters - both radio and television - to pay royalty to the owners of the copyright each time a work of art is broadcast. It bans people from bringing out cover versions of any literary, dramatic or musical work for five years from the first recording of the original creation. The law also seeks to remove operational difficulties and address newer issues related to the digital world.

Limited Protection to Some Internet Intermediaries: There are two new provisions, which provide some degree of protection to 'transient or incidental' storage of a work or performance. Section 52(1)(b) allows for the transient or incidental storage of a work or performance purely in the technical process of electronic transmission or communication to the public, hence applying primarily to Internet Service Providers (ISPs), VPN providers, etc. Section 52(1)(c) allows for transient or incidental storage of a work or performance for the purpose of providing electronic links, access or integration, where such links, access or integration have not been expressly prohibited by the right holder, unless the person responsible is aware or has reasonable grounds for believing that such storage is of an infringing copy. This seems to make it applicable primarily to search engines, with other kinds of online services being covered or not covered depending on one's interpretation of the word 'incidental'.

COMPUTER FUNDAMENTALS

Computer is an electronic device that can count, save and solve complex problems with high accuracy and speed.

- **Input:** The source data entered into a data processing system.
- **Central Processing Unit:** The Arithmetic Logic Unit (ALU) and Control Unit (CU) together are termed as the Central Processing Unit. It is the brain of any computer system. All calculations and comparisons are made inside the CPU.
- **Control Unit:** The part of Central Processing Unit which directs the sequence of operating, interprets and coded instruction and sees to the execution of program instruction.
- **Arithmetic Logic Unit:** The part of CPU, which performs the arithmetical and logical operations.
- **Storage:** The storage or primary section of computer consists of the devices used to store the information. Example: Magnetic cores, RAM chips, etc.

- **Output:** The finished result of processing by a system.

Classification of Computer

- **Analog Computer:** Computers that measure physical quantities e.g. pressure, temperature, voltage etc. They are used mainly for scientific and engineering purpose.
- **Digital Computer:** Computer that counts and accepts letters and numbers through various input devices. It can be used in various applications.
- **Hybrid Computer:** The features of analog and digital machines are combined to create a hybrid computing system.
- **Mainframe Computers:** Computers with high capability but less powerful and cheaper than supercomputers. These are suited for big organizations to manage high volume of applications e.g. MEDHA, Sperry DEC, IBM, HP, ICL etc.
- **Mini Computers:** Relatively fast and small and inexpensive computer with somewhat limited input/output capabilities. The first popular minicomputer was the PDP-8, launched in 1965.
- **Micro Computers:** Full-fledged computer system that uses micro processor as their CPU. These are also called personal computer system.

Computer Devices

- **Input Devices:** These are used for transferring user command or data to the computer. e.g.- Keyboard, Mouse, Light pen etc.
- **Keyboard:** The keyboard is one of the most common input device for computers. The layout of the keyboard is like that of the traditional QWERTY typewriter, although there are some extra command and function keys provided for.
- **Mouse:** Mouse is a handy device which can be moved on a smooth surface to simulate the movement of cursor that is desired on the display screen.
- **Light pen:** This is a pen shaped pointing device which can be used to select an option by just pointing at it, or drawing figures directly on the screen and moving the figures around.
- **Scanners:** It facilitates capturing of the information and storing them in graphic format for displaying back on the graphical screen.
- **Output Devices:** Peripherals used to output results to the user. e.g.- Printers, VDU (Visual Display Unit)
- **Printers:** Output devices are used to produce hard copy of computer output that is readable by humans.
- **Ink Jet Printer:** A printing device that uses a nozzle and sprays ink into paper to form the appropriate characters. The typing speed range from 50 cps above 300 cps.
- **Laser Printer:** A very high speed printer that uses a combination of laser beam and electro-photographic techniques to create printed outputs at a speed in excess of 13,000 lines per unit. Speed can range from 10 pages a minute to about 200 pages per minute.
- **Floppy Disk:** Popular magnetic device for small computer introduced by IBM in 1972. It is flexible and has a plastic jacket coated with iron oxide material. Data and information stores in the disks as a magnetic and non-magnetic spots. It is a non erasable disc used for storing computer data.
- **Programming Language:** Computer programming is the name given to the 'art' of writing a programme in a programming language, which is a higher-level language. In a binary-coded digital computer, the machine language is made of Os and 1s to relieve the programme in the difficult low-level machine language, several hundreds of easier high level programming language have been developed, such as, FORTRAN, BASIC, COBOL, PASCAL, C, C++ etc.
- **Memory:** The data, which are stored in a computer, are called its memory. A computer's memory has actually two memories-one permanent, and the other temporary.

(i) ROM (Read Only Memory): ROM is

permanent in nature. Neither you nor the computer has any control over the information in ROM. Here, the manufacturer has placed special data that can be used, but not erased or changed.

(ii) **RAM (Random Access Memory):** RAM handles all input, each electronic switch storing one bit. The more RAM a computer has, the more information it can store. However, it presents a special problem- it works only as long as electric current flows through it. Without a current, all the stored information is wiped out.

- **Speed:** Computer speeds are measured in terms of million instructions per second (MIPS), which reflects the number of instructions the processor at the heart of computer can perform.
- **Mass Storage:** Information can be stored permanently on magnetic tape on a floppy disc, a thin flexible disc coated with magnetic particles, or on a hard disc. These media store bits (zeros and ones) as magnetic strips running in either one direction (signifying O) or the other (signifying 1). Mass storage device can then retrieve (read) the data, change it, and again store (write) it onto tape or disc.
- **IP Telephony:** Internet Protocol Telephony encompasses many different ways of transmitting voice, fax and related services. IP stands for low cost or even free voice calls. On the other voice IP (Vo IP) is much more than Internet Telephony for the core network operators, local exchanges and corporate enterprises.
- **Global System for Mobile (GSM):** The Global System for Mobile (GSM) is a worldwide dominant system that originally evolved as a pan-European digital standard, and built a base in the US and Canada at a rapid pace. GSM uses Time Division Multiple Access (TDMA). TDMA is not a spread spectrum technology. It uses a narrow band that is 30 KHZ wide and 6.7 milliseconds long. This is split times-wise into slots. Each conversation gets the radio for part of the time.
- **Code-Division Multiple Accesses (CDMA):** The Code-Division Multiple Access (CDMA) technology, also known as digital mobile technology, came into the picture after the entry of the GSM. CDMA, due to its technological superiority, is presently the biggest challenger to GSM. In CDMA, the data is digitized and spread over the entire available bandwidth, unlike the narrow band of TDMA. Multiple calls are overlaid on each other on the channel, with each assigned a unique sequence code. The data is then reassembled at the receiver's end. The battery life of CDMA handsets is longer than that of analogue phones, with a talk time of three to four hours, and up to two-and-a-half weeks of standby time.
- **Digital Signature:** Digital Signature is extra data appended to a message which identifies and authenticates the sender and the data using public key encryption. The signature is issued by the control of certifying authorities. Not many companies are willing to apply for CA (certifying authority). The government had stipulated that a CA should have a minimum paid up capital of Rs. 5 crore and a net worth of Rs. 50 crore.
- **PAGING:** It provides a one-way wireless communication to the wandering users. In this system, the messages are sent to the subscribers, which consist of small receiver.
- **Electronic Mail (E-Mail):** E-mail involves non-interactive communication of information between the sender and a receiver. The information may be in the form of text or data image or voice message.
- **FAX:** Fascimile transfer of messages, i..e., FAX is used for transmission of weather charts, engineering drawings, and even handwritten notes.
- **Voice Mail:** If someone wants to enjoy the benefits of a telephone, without actually owning one, he should subscribe to voice mail.
- **Electronic Data Interchange (EDI):** It enables usually a customer and supplier to exchange routine documents, such as, purchase orders and invoices using standard electronic forms and their own computers, linked through a service provider.
- **Video Conferencing:** Video conferencing or Electronic conferencing allows persons sitting in different parts of the city, country or world to meet face-to-face without

actually being there. This is possible with the help of special cameras attached to computers. The images are digitalised and bounced to the place to a person's choice by means of a modem attached to the computer.

- **Video Tex:** It is the generic name of systems which transmit text and graphic information stored in the computer database via the telephone network for display on a television screen. The user indicates the information he would like from the database and the computer sends it to the user.
- **Virtual Reality:** It enables a person to enter the world to three-dimensional (3-D) computer-aided image. It is not like any computer graphic. In fact, it accords multiple sensory information, sight, sound and touch in an effort to make the situation realistic.
- **DTH Transmission:** The Direct to Home (DTH) services are all set to make an entry in the Indian homes in the near future. In DTH, the move from C-Band to Ku-Band means that DTH providers would be in a position to offer up to 100 channels. They would also offer value-added services like interactive media, tele-banking, tele-shopping, satellite telephony, video-on-demand.
- **Liquid Crystal Display:** Thanks to the new developments in Liquid Crystal Display (LCD) technology, the curved television screen - known as cathode ray tube - may give to a flat screen that can be hung on a wall like a painting. Presently, LCDs are used in a wide range of applications, including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones.
- **Multi-media:** Multi-media means integration of two or more media elements. It is one of the most recent information technologies that is becoming popular world-wide due to its multi-dimensional approach and uses.

❖❖❖

ROBOTICS TECHNOLOGY

CHRONICLE IAS ACADEMY
A CIVIL SERVICES CHRONICLE INITIATIVE

INTRODUCTION

The word "robot" originates from the Czech word for forced labour, or serf. It was introduced by playwright Karel Capek, whose fictional robotic inventions were much like Dr. Frankenstein's monster — creatures created by chemical and biological, rather than mechanical, methods. But the current mechanical robots of popular culture are not much different from these fictional biological creations.

Robotics technology is developing at a rapid pace, opening up new possibilities for automating tasks and enriching the lives of humans. From the automobile assembly line to automatic home, vacuum cleaners, robotics has become part of our world.

Robotics is the branch of engineering science and technology that deals with the design, manufacture, operation, and application of robots. Robotics is related to electronics, mechanics, and software.

According to the "Robot Institute of America," 1979, "A robot is defined as a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks." A robot is described as a machine designed to execute one or more tasks repeatedly, with speed and precision. There are as many different types of robots as there are tasks for them to perform.

PAST & FUTURE OF ROBOTS

First-generation robots date from the 1970's and consists of stationary, nonprogrammable, electromechanical devices without sensors. Second-generation robots were developed in the 1980's and could contain sensors and programmable controllers. Third-generation robots were developed between approximately 1990 up to the present. These machines can be stationary or mobile, autonomous or insect type, with sophisticated programming, speech recognition and/or synthesis, and other advanced features.

Fourth-generation robots are in the research-and-development phase, and include features such as artificial intelligence, self-replication, self assembly, and nanoscale size (physical dimensions on the order of nanometers, or units of 10 -9 meter).

A few advanced robots are called androids because of their superficial resemblance to human beings. Androids are mobile, usually moving around on wheels or a track drive because most robots legs are unstable and difficult to engineer. The android is not necessarily the end point of robot evolution.

Asimov

Asimov is generally credited with the popularization of the term "Robotics" which was first mentioned in his story "Runaround" in 1942. But probably Isaac Asimov's most important contribution to the history of the robot is the creation of his 'Three Laws of Robotics':

1. A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Asimov later adds a "Zeroth law" to the list:

Zeroth law: A robot may not injure humanity, or, through inaction, allow humanity to come to harm, unless this would violate a higher order law.

In 1959, John Minsky started the Artificial

Intelligence Laboratory at the Massachusetts Institute of Technology (MIT).This was funded by Rockefeller Foundation. This gave impetus to the field of robotics.

PARTS OF ROBOT

Arm

The 'Robotic Arm' of an industrial robot with six joints closely resembles a human arm — it has the equivalent of a shoulder, an elbow and a wrist. Typically, the shoulder is mounted to a stationary base structure rather than to a movable body. This type of robot has six degrees of freedom, meaning it can pivot in six different ways. A human arm, by comparison, has seven degrees of freedom. Your arm's job is to move your hand from place to place. Similarly, the robotic arm's job is to move an end effector from place to place. You can outfit robotic arms with all sorts of end effectors, which are suited to a particular application.

Controller

Digital computer is major controller of a robot. The robot's computer controls everything attached to the circuit. To move the robot, the computer switches on all the necessary motors and valves. Most robots are reprogrammable — to change the robot's behaviour, you simply write a new program to its computer. The actuators are all wired to an electrical circuit. The circuit powers electrical motors and solenoids directly, and it activates the hydraulic system by manipulating electrical valves. The valves determine the pressurized fluid's path through the machine. To move a hydraulic leg, for example, the robot's controller would open the valve leading from the fluid pump to a piston cylinder attached to that leg. The pressurized fluid would extend the piston, swiveling the leg forward. Typically, in order to move their segments in two directions, robots use pistons that can push both ways.

Sensors

Sensors are the instruments that measure position, force, temperature, etc. Not all robots have sensory systems, and few have the ability to see, hear, smell or taste. The most common robotic sense is the sense of movement — the robot's ability to monitor its own motion. A standard design uses slotted wheels attached to the robot's joints. An LED on one side of the wheel shines a beam of light through the slots to a light sensor on the other side of the wheel. When the robot moves a particular joint, the slotted wheel turns. The slots break the light beam as the wheel spins. The light sensor reads the pattern of the flashing light and transmits the data to the computer.

End Effectors

End Effector is like human palm and fingers. We can outfit robotic arms with all sorts of end effectors, which are suited to a particular application. One common end effector is a simplified version of the hand, which can grasp and carry different objects. Robotic hands often have built-in pressure sensors that tell the computer how hard the robot is gripping a particular object. This keeps the robot from dropping or breaking whatever it's carrying. Other end effectors include blowtorches, drills and spray painters.

TYPES OF ROBOTS

Broadly there are two types of robots:

Robots on Earth or Industrial Robots: Typical industrial robots do jobs that are difficult, dangerous or dull. They lift heavy objects, paint, handle chemicals, and perform assembly work. They perform the same job hour after hour, day after day with precision. They don't get tired and they don't make errors associated with fatigue and so are ideally suited for performing repetitive tasks. The major categories of industrial robots by mechanical structure are:

1. **Cartesian Robot/Gantry Robot:** Used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding. It is a robot whose arm has three prismatic joints, whose axes are coincident with a Cartesian coordinator.
2. **Cylindrical Robot:** Used for assembly operations, handling of machine tools, spot welding, and handling of die casting machines. It's a robot whose axis form a cylindrical coordinate system.
3. **Spherical/Polar Robot:** Used for handling of machine tools, spot welding, die casting, fettling machines, gas welding

and arc welding. It's a robot whose axis form a polar coordinate system.

4. **SCARA Robot:** Used for pick and place work, application of sealant, assembly operations and handling machine tools. It's a robot which has two parallel rotary joints to provide compliance in a plane.
5. **Articulated Robot:** Used for assembly operations, die casting, fettling machines, gas welding, arc welding and spray painting. It's a robot whose arm has at least three rotary joints.
6. **Parallel Robot:** One use is a mobile platform handling cockpit flight simulators. It's a robot whose arms have concurrent prismatic or rotary joints.

APPLICATIONS OF ROBOTS

Robots are used for the following reasons:

- Repetitive tasks that robots can do 24/7.
- Robots never get sick or need time off.
- Robots can do tasks considered too dangerous for humans.
- Robots can operate equipment to much higher precision than humans.
- May be cheaper over the long run.
- May be able to perform tasks that are impossible for humans.

(A) Industrial Robots are used in

- General materials handling
- Welding industries
- Inspection
- Improving productivity by increasing per capita production
- Laboratory applications

(B) Exploration

Robots are used in space missions. In 2002 NASA launched the MER-A "Spirit" rover destined for Mars.

Robots in the Antarctic Exploration Researchers from the Thayer School of Engineering at Dartmouth College have built a robot designed to do research in Antarctica. This robot is a general purpose mobile platform that can carry various instruments and travel in polar temperatures.

Exploring Volcanoes: Volcanologists have identified that a volcano exploration robot should be able to carry out a number of key operations, the most important being the ability to:

- approach an active volcanic vent
- collect samples of volcanic eruption products
- collect other physical and chemical data
- survey close to vent openings

(C) Medical Field

Robots are critical to the medical field where extreme precision and delicacy is necessary, and the margin for error is slim.

- **In the Field of Surgery:** Because robots are able to perform major operations while only making small incisions, patients get many benefits: lessened trauma, fewer infections, decreased healing time, and a faster discharge from the hospital. Robots are used to perform heart surgery without opening patient's chests.
- **In Medical Education:** Robots are currently used to test medical students. Pregnant humanoid robots, for instance, prepare students for various birth complications.
- **In Hospital Administration:** Robots are also affecting the way hospitals are run and medications distributed. They make sure hospital visits are shorter and the risk of infection minimized.

(D) Robots in Space

Space-based robotic technology at NASA falls within three specific mission areas: exploration robotics, science payload maintenance, and on-orbit servicing. Related elements are terrestrial/commercial applications which transfer technologies generated from space telerobotics to the commercial sector and component technology which encompasses the development of joint designs, muscle wire, exoskeletons and sensor technology.

NEW DEVELOPMENT IN ROBOTICS

Modular Robots

Modular robots are a new breed of robots

that are designed to increase the utilization of the robots by modularizing the robots. Modular robots are capable of adapting their morphology to tasks and environment, which makes them more versatile, flexible and robust compared to fixed-bodied ones. Most current systems lack mechanical flexibility when increasing the number of modules due to hard building blocks (modules) and highly rigid connection mechanisms. Although this design guarantees controllability and stability, it minimizes flexibility. In order to improve adaptation to environmental changes, softness on the module level might be beneficial.

Nanorobots

Nanorobotics is the emerging technology field of creating machines or robots whose components are at or close to the microscopic scale of a nanometer (10 -9 meters). Also known as "nanobots" or "nanites", they would be constructed from molecular machines.

Nanobots have been popular staples in science fiction for some time, and have experienced periods of relative popularity among futurist communities. Although they have been created in a biological context, no actual mechanical nanobots have yet been created, but they remain an area of active research and hold a great deal of promise for a number of fields. So far, researchers have mostly produced only parts of these complex systems, such as bearings, sensors, and synthetic molecular motors. Possible applications include micro surgery (on the level of individual cells), utility fog, manufacturing, weaponry and cleaning.

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is the area of computer science focusing on creating machines that can engage on behaviours that humans consider intelligent. The ability to create intelligent machines has intrigued humans since ancient times and today with the advent of the computer and 50 years of research into AI programming techniques, the dream of smart machines is becoming a reality. Researchers are creating systems which can mimic human thought, understand speech, beat the best human chess player, and countless other feats never before possible. Find out how the military is applying AI logic to its hi-tech systems, and how in the near future Artificial Intelligence may impact our lives.

Approaches to AI

Initially, researchers thought that creating an AI would be simply writing programs for each and every function an intelligent person performs. As they went on with this task, they realized that this approach was too shallow. Even simple functions like face recognition, spatial sense, pattern recognition and language comprehension were beyond their programming skills.

They understood that to create an AI, they must delve deeper into natural intelligence first. They tried to understand how cognition, comprehension, decision-making happen in the human mind. They had to understand what understanding really means. Some went into the study of the brain and tried to understand how the network of neurons creates the mind. Thus, researchers branched into different approaches, but they had the same goal of creating intelligent machines.

Neural Networks

This is the bottom up approach. It basically aims at mimicking the structure and functioning of the human brain, to create intelligent behaviour. Researchers are attempting to build a silicon-based electronic network that is modelled on the working and form of the human brain. Our brain is a network of billions of neurons, each connected with the other.

At an individual level, a neuron has very little intelligence, in the sense that it operates by a simple set of rules, conducting electric signals through its network. However, the combined network of all these neurons creates intelligent behaviour that is unrivaled and unsurpassed. So these researchers created network of electronic analogues of a neuron, based on Boolean logic. Memory was recognized to be an electronic signal pattern in a closed neural network.

How the human brain works is, it learns to realize patterns and remembers them. Similarly, the neural networks developed have the ability to learn patterns and remember. This approach has its limitations due to the scale and complexity

of developing an exact replica of a human brain, as the neurons number in billions. Currently, through simulation techniques, people create virtual neural networks. This approach has not been able to achieve the ultimate goal but there is a very positive progress in the field. The progress in the development of parallel computing will aid it in the future.

Expert Systems

This is the top down approach. Instead of starting at the base level of neurons, by taking advantage of the phenomenal computational power of the modern computers, followers of the expert systems approach are designing intelligent machines that solve problems by deductive logic. It is like the dialectic approach in philosophy.

This is an intensive approach as opposed to the extensive approach in neural networks. As the name expert systems suggest, these are machines devoted to solving problems in very specific niche areas. They have total expertise in a specific domain of human thought. Their tools are like those of a detective or sleuth. They are programmed to use statistical analysis and data mining to solve problems. They arrive at a decision through a logical flow developed by answering yes-no questions.

Chess computers like Fritz and its successors that beat chess grandmaster Kasparov are examples of expert systems. Chess is known as the drosophila or experimental specimen of artificial intelligence.

Applications of AI

Artificial Intelligence in the form of expert systems and neural networks has applications in every field of human endeavour. They combine precision and computational power with pure logic, to solve problems and reduce error in operation. Already, robot expert systems are taking over many jobs in industries that are dangerous for or beyond human ability. Some of the applications divided by domains are as follows:

- ***Heavy Industries and Space***

Robotics and Cybernetics have taken a leap combined with artificial intelligent expert systems. An entire manufacturing process is now totally automated, controlled and maintained by a computer system in car manufacture, machine tool production, computer chip production and almost every high-tech process. They carry out dangerous tasks like handling hazardous radioactive materials. Robotic pilots carry out complex manoeuvering techniques of unmanned spacecrafts sent in space. Japan is the leading country in the world in terms of robotics research and use.

- ***Finance***

Banks use intelligent software applications to screen and analyze financial data. Softwares that can predict trends in the stock market have been created which have been known to beat humans in predictive power.

- ***Computer Science***

Researchers in quest of artificial intelligence have created spin offs like dynamic programming, object oriented programming, symbolic programming, intelligent storage management systems and many more such tools. The primary goal of creating an artificial intelligence still remains a distant dream but people are getting an idea of the ultimate path which could lead to it.

- ***Aviation***

Airlines use expert systems in planes to monitor atmospheric conditions and system status. The plane can be put on auto pilot once a course is set for the destination.

- ***Weather Forecast***

Neural networks are used for predicting weather conditions. Previous data is fed to a neural network which learns the pattern and uses that knowledge to predict weather patterns.

- ***Swarm Intelligence***

This is an approach to, as well as application of artificial intelligence similar to a neural network. Here, programmers study how intelligence emerges in natural systems like swarms of bees even though on an individual level, a bee just follows simple rules. They study relationships in nature like the prey-predator relationships that give an insight into how intelligence emerges in a swarm or collection from simple rules at an individual level. They develop intelligent systems by creating agent programs that mimic the behavior of these natural systems.

Robots and Artificial Intelligence

Like the term "robot" itself, artificial intelligence is hard to define. Ultimate AI would be a recreation of the human thought process — a man-made machine with our intellectual abilities. This would include the ability to learn just about anything, the ability to reason, the ability to use language and the ability to formulate original ideas. Roboticists are nowhere near achieving this level of artificial intelligence, but they have had made a lot of progress with more limited AI. Today's AI machines can replicate some specific elements of intellectual ability.

Computers can already solve problems in limited realms. The basic idea of AI problem-solving is very simple, though its execution is complicated. First, the AI robot or computer gathers facts about a situation through sensors or human input. The computer compares this information to stored data and decides what the information signifies. The computer runs through various possible actions and predicts which action will be most successful based on the collected information. Of course, the computer can only solve problems, it's programmed to solve — it doesn't have any generalized analytical ability. Chess computers are one example of this sort of machine.

Some modern robots also have the ability to learn in a limited capacity. Learning robots recognize if a certain action (moving its legs in a certain way, for instance) achieved a desired result (navigating an obstacle). The robot stores this information and attempts the successful action the next time it encounters the same situation. Again, modern computers can only do this in very limited situations. They can't absorb any sort of information like a human can. Some robots can learn by mimicking human actions. In Japan, Roboticists have taught a robot to dance by demonstrating the moves themselves.

Some robots can interact socially. Kismet, a robot at M.I.T's Artificial Intelligence Lab, recognizes human body language and voice inflection and responds appropriately. Kismet's creators are interested in how humans and babies interact, based only on tone of speech and visual cue. This low-level interaction could be the foundation of a human-like learning system.

Kismet and other humanoid robots at the M.I.T. AI Lab operate using an unconventional control structure. Instead of directing every action using a central computer, the robots control lower-level actions with lower-level computers. The program's director, Rodney Brooks, believes this is a more accurate model of human intelligence. We do most things automatically; we don't decide to do them at the highest level of consciousness.

The real challenge of AI is to understand how natural intelligence works. Developing AI isn't like building an artificial heart — scientists don't have a simple, concrete model to work from. We do know that the brain contains billions and billions of neurons, and that we think and learn by establishing electrical connections between different neurons. But we don't know exactly how all of these connections add up to higher reasoning, or even low-level operations. The complex circuitry seems incomprehensible.

❖❖❖